The Cyclical Behaviour of IPO Markets

By

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To Jane with love

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CANDIDATE'S STATEMENT

In compliance with the requirements relating to admission to examination and submission of theses, for the Degree of Doctor of Philosophy at the Australian National University, I hereby certify that, unless otherwise stated, the work which follows is my own and has not been submitted for a higher degree to any other institution or University.

Jing Shi

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THESIS PUBLICATIONS

Some of the work in this thesis has been extended, edited and rewritten into papers.

A paper sourced from parts of Chapters four, five and six, titled "Hot and Cold IPO Markets", has been accepted for publication in the *Multinational Finance Journal*.

Another paper sourced from parts of Chapters four, five and seven, titled "The Cyclical Behaviour of the IPO Market in Australia", has been accepted for publication in the *Accounting Research Journal*.

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Of course, I am responsible for any errors contained herein.

THESIS ABSTRACT

Initial public offerings (IPOs) are the mechanism by which private firms raise initial public equity and obtain listing on a stock exchange. The role and importance of IPOs has changed over time and they now represent a significant portion of market activity. IPOs present challenges for both researchers and academics given their problems in valuation and pricing, information asymmetry and information quality. Prior research has concentrated on analysis of individual IPOs, or at least aggregated statistics thereof. In this thesis, the aggregate market for IPOs is examined. The focus of the thesis is mainly empirical, consisting of a number of related studies that examine the time-series and cross-sectional behaviour of volume and pricing measures of aggregate IPO activity, concentrating on the Australian and US markets.

The early chapters demonstrate strong time-series features in the two markets which can be captured by regime-switching models. The results indicate that IPO markets exhibit characteristics consistent with momentum and "hot" periods. Moreover, there are signals contained in the relationship between volume and pricing measures such that under-pricing leads volume. Various reasons are advanced for this finding, mainly surrounding institutional requirements. The thesis then examines the influence of economic and financial conditions on the IPO market. Consistent with a number of hypotheses, the findings reveal that the business cycle, stock market conditions, investor sentiment and volatility exhibit a significant influence over IPO activity. These results contain messages and implications for intending issuers, investors and market regulators. Finally, a cross-market study is undertaken in which the relationship between the Australian and US markets is analysed with the results confirming the relative dominance of the US market.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction

Initial public offerings (or IPOs) are security issues, typically in the form of equity, that are offered to investors through a listing on the stock exchange. An IPO is generally the first effort by a firm to raise capital in a public equity market. Publicly traded stocks offer greater liquidity, which allows the firm to generate funds on more favorable terms than where privately owned.

Over the period 1960-1996, there were 2,271 IPOs issued in the Australian equity market which translates to an average of about 7 new floats per month. In comparison, there were around 11,000 new issues in the US market over the same period which translates to an average of about 25 IPOs per month. Government policy decisions over the last decade have fuelled further interest through the process of privatisation. For instance, Australia has followed the lead of the Thatcher government in the UK in the 1980s and pursued floats of public institutions such as the Commonwealth Bank, Qantas and Telstra. Further, the de-mutualisation of several large entities, such as AMP and the Australian Stock Exchange itself, have done much to attract small investors to the stock market through IPO subscriptions.

While IPOs have been a common feature of stock markets for many years, over the last decade or so they have also attracted research interest. Research into IPOs has generally fallen into three main categories. First, the issue of short-run performance has been subject to widespread research. This work has generally found that there is a frequent incidence of large initial returns in IPO stocks generated over the first few days of listing, that is, IPOs tend to be underpriced (e.g. Finn and Higham 1988; Ritter 1984a; How et al. 1995; Ibbotson et al. 1994; Lee et al. 1996a and 1996b; Loughran et al. 1994). Generally, the average first day stag profit has been somewhere around 10-30%, although the exact amount varies across markets and sample periods. Nevertheless, the consistent result of underpricing has been documented in most developed and many emerging markets. For instance, two studies report the average IPO initial return between 12% and 29% in Australia and these figures are quite close to 15.8% reported in the USA (e.g. Ibbotson et al. 1994).[1] A number of papers have proposed theoretical models to explain the IPO price behaviour with mixed results.[2] These models typically rely upon information asymmetries (e.g. Baron 1982; Rock 1986), or market imperfections generally created through information problems (e.g. Mauer and Senbet 1992; Muscarella and Vetsuypens 1989a and 1989b).

Second, a group of papers have examined the long-run performance of IPOs. Generally, the tracking of price performance over a number of years following listing has shown that IPOs tend to underperform established benchmarks (e.g. Aggarwal et al. 1993; Ritter 1991).[3]

A third category of research has examined the characteristics associated with the issue itself, such as the role of underwriters and investment banks (e.g. Affleck-Graves and Miller 1989; Carter and Manaster 1990; Carter et al. 1998), the impact of auditor choice (e.g. Beatty 1989; Feltham et al. 1991; Firth and

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[1] See Finn and Higham (1988), How et al. (1995) and Lee et al. (1996a).
[2] For example, Baron (1982), Rock (1986), and Welch (1989,1992).
[3] The return on a market index is normally used as a benchmark.

Smith 1992) and the disclosure of prior information (e.g. Chaney and Lewis 1998; Firth 1997; Kim and Ritter 1999).

There has also been some attempt to examine the IPO market in aggregate. These latter studies have presented evidence that cycles appear to exist in both the volume and the average initial returns of IPOs. These cycles give rise to the concept of 'hot' and 'cold' markets with a 'hot issue' market characterised by an unusually high volume of new offerings, severe underpricing and frequent oversubscription of offerings (Ritter 1998; Helwege and Liang 1996a). However, the behaviour of the aggregate IPO market has generally only been covered briefly in the context of other issues.

1.2 Cycles in the IPO Market

'Hot' issues were first defined by Ibbotson and Jaffe (1975) as IPOs that are extremely underpriced, while a hot issue market is a market with a considerable number of extremely underpriced issues. Identification of hot issue markets would therefore focus on the number of extremely underpriced IPOs, but any definition of 'extreme underpricing' would be arbitrary and is time-dependent, so researchers have instead examined average monthly underpricing of IPOs as well as the monthly volume of new issues, when investigating hot issue markets (Ritter 1984b; Ibbotson et al. 1994; Ritter 1998). An operational definition of a hot issue market is a market with an unusually high volume of new offerings, severe under-pricing and frequent over-subscription of offerings (Ritter 1998; Helwege and Liang 1996a).

In an efficient market and in the absence of market imperfections, the timing of equity financing decisions should not matter since an IPO should be fairly priced (Brealey and Myers 1991). The consequent implication is straightforward. That is, IPOs should occur randomly across time and hot and cold issue IPO markets should not exist. However, empirical evidence contradicts this theory, in that cycles are observed in both IPO underpricing and volume (e.g. Choe et al. 1993; Ibbotson and Jaffe 1975; Helwege and Liang 1996a; James and Kieschnick 1997; Loughran et al. 1994; Ritter 1984b, 1998). There are a few arguments as to why the IPO market may run hot and cold.

By applying Rock's (1986) model, Ritter (1984b) suggests a changing risk composition hypothesis and argues that if high risk IPOs represent an unusually large proportion of offerings in some specific periods, high average IPO under-pricing should be observed in these periods.

A second explanation of hot issue periods concerns positive feedback strategies where investors assume positive correlation in initial IPO returns such that initial returns are likely to be bid up if other recent issues have risen in price. The argument is linked to similar arguments of investor sentiment used to explain apparent patterns in the stock market. That is, markets gain momentum through fads and shifts in investor sentiment. However, the hypothesis of a positive feedback strategy does not explain how hot markets commence in the first instance. Of note, to some extent these arguments are inconsistent with standard theory because they rely on some degree of investor irrationality and/or market inefficiency.

Previous studies have not attempted to clearly identify structural breaks that separate different regimes in the IPO market. Hence, the questions of how frequent the hot issue markets are, dating when they occur, and identifying the features associated with these markets, remain unanswered. Although there have been some attempts to explain the existence of hot issue IPO markets, the explanations have generally not proved to be satisfactory in fully accounting for the observed market behaviour. Moreover, existing explanations focus on specific characteristics that are either demand or supply-side driven and generally ignore more comprehensive and multivariate approaches. Further, there exists no in-depth analysis of the interdependence among national IPO markets. Loughran et al. (1994) document evidence of the short-run and long-run performance of IPOs in fifteen countries but does not further examine the interrelationship between these countries. In this thesis, I seek to provide some insights into these questions.

1.3 Motivation

An important distinguishing feature of the market for initial public offerings is the tendency of the market to undergo periods of concentrated activity whereby the number of new issues coming to the market and the extent of IPO underpricing both appear to substantially increase. These 'hot issue' periods attract enormous investor interest and media attention because of their perceived potential for short term trading profits. However, much less academic attention has been directed towards examining the cyclical nature of hot and cold IPO markets, with the literature instead focusing on theoretical and cross-sectional explanations of IPO underpricing and long run underperformance. This thesis explores the hot issue market question using the US and Australian IPO data and is empirically based. This is in part motivated by the lack of previous work in this area.

Second, Ibbotson and Jaffe (1975) first documented that the degree of IPO underpricing is cyclical and concentrated in particular periods (1960-1961 and 1968-1969) in the US market. Ritter (1984b) shows that there was also a hot issue market in 1980 in the USA using the data for the period 1977-1982. A weakness in the above studies is that they use a relatively short time period in the analysis. Any potential hot issue periods after 1982 still remain unexplored. In this thesis, a relatively long time period for both Australian and US IPO markets (compared with the existing literature) is used to ascertain the existence of hot issue IPO markets in both Australia and the USA, explore the persistence of the hot issue IPO markets, and further detect hot issue periods which might exist.[4]

Third, IPO activity has traditionally been viewed in terms of three measures – a volume measure such as the number of IPO issues, a pricing measure such as the average level of underpricing, and a value measure such as the total value of new issues. This study examines the three traditional measures of IPO activity as well as a newly-developed fourth measure, the total value of underpricing, which captures the economic importance of IPO underpricing. These measures, taken together, indicate how many IPOs occurred in a month and whether the IPOs that occurred during the month were important from a value perspective. Contrary to previous studies where the question of hot and cold IPO markets is explored using only one or two IPO activity measures, all these four measures are examined in this thesis. This sheds further lights on questions such as whether hot issue periods are homogeneous in each measure and whether there is a lead-lag relationship between the measures.

[4] The data used in the thesis covers the period from 1976 to 1998.

Fourth, Ibbotson and Jaffe (1975) first documented that the degree of IPO underpricing is cyclical and concentrated in particular periods in the USA. Ritter (1984b), using US data for the period 1960-1982, shows that there was also a hot issue market in 1980. The hot issue periods observed in the above two studies are based on descriptive analysis, typically from a visual inspection of the data series. Subsequent studies have generally also used graphical or visual analysis to describe hot and cold periods and have not attempted to clearly identify structural breaks that separate different regimes (e.g. Ibbotson et al. 1994; Loughran et al. 1994). Without clear identification of hot periods, it is difficult to construct further tests that attempt to explain the existence of such periods. In this thesis, I identify the hot and cold IPO periods using a more appropriate statistical method, the Markov regime switching technique, as well as other turning points identification methods, such as visual analysis and the Bry and Boschan method. In particular, the application of Markov regime-switching to IPO data provides a multi-dimensional characterization of IPO cycles in terms of active versus inactive market volume, and hot versus cold underpricing.

Fifth, there have been some prior attempts to explain the existence of hot issue IPO markets. However, these explanations have generally not proved to be satisfactory in fully accounting for the observed market behaviour. In addition, existing explanations generally focus on specific characteristics that are either demand or supply-side driven. In this thesis, hypotheses are developed with consideration to economic and stock market variables based on both supply and demand considerations. These hypotheses are tested using a time-series sample of US new issues.

Sixth, although there exists some existing research in the area of hot issue IPO markets, it mainly focuses on the US market. Research on other international IPO markets is still scant. There may be an interrelationship between the US and other international IPO markets. This thesis fills this gap by exploring the hot and cold issue periods in Australian IPO activity and the financial linkage between the US and Australian IPO markets.

1.4 Objectives and Contribution

This thesis has five objectives and contributions. First, it employs a long run IPO data series and develops four IPO activity measures. The first volume measure, the number of IPOs per month (NOIPO), expressed as a percentage of the total number of IPOs in the data set, is consistent with previous work (e.g. Ibbotson et al. 1994; Loughran et al. 1994). The second volume measure, the inflation-adjusted gross value of IPO proceeds per month (GP), is also expressed as a percentage of total proceeds in the entire data set and is also consistent with the literature (Rees 1997). An IPO underpricing measure used in this thesis, value-weighted underpricing (VWUP), improves upon previous measures of underpricing by weighting each issue's contribution to monthly underpricing according to the relative size of the issue within the month. This avoids the problem whereby traditional arithmetic average measures of underpricing are subject to too much influence from small 'penny' stocks (e.g. Ibbotson and Ritter 1995). The second measure of IPO underpricing, the value of underpricing (VUP), measures the total value of underpricing in a particular month divided by total value of underpricing in the entire sample (expressed as a percentage), thereby indicating whether underpricing in a particular month is economically important. These measures provide a better description of IPO activity.

Second, this thesis formally documents the existence of hot issue periods in the USA and Australia using a regime-switching model as well as visual analysis and a dating algorithm developed by Bry and Boschan (1971). This contribution has several advantages. First, it identifies in a quantitative manner hot and cold IPO periods in the USA and Australian markets. While there is general acceptance in the literature that such periods exist, there have previously been no formal attempts to quantify these periodic episodes. In so doing, existing knowledge is enhanced. Second, using a Markov regime switching model in addition to visual analysis and the turning points identification method, the thesis provides an objective determination of the dates of hot and cold issue periods. Again, this represents the first attempt in the literature to do so. Objective dating and characterization of hot and cold markets can be important for the development and empirical testing of models of IPO cycles. Third, there is evidence on the relationship between IPO underpricing and volume where underpricing leads the IPO volume by up to six months. The documentation of this feature provides new insights to researchers seeking explanations of IPO cycles and to market participants who are either seeking to bring new issues to the market or looking to invest in IPOs.

Third, Ritter (1984b) suggests a changing risk composition hypothesis to explain the 1980 hot issue market. He argues that if high risk IPOs represent an unusually large proportion of offerings in some specific periods, high average IPO underpricing should be observed in these periods. Ritter suggests that the hot period in 1980 was characterised by a large number of small, natural resource issues and that only these issues appeared excessively underpriced during the period. Since the Australian stock market consists of a relative large proportion of resource sector stocks compared to other markets, it provides an opportunity for an examination of the difference in behaviour between industrial and resource sector IPOs. Hence, the analysis of the Australian IPO activity involves separate consideration of the industrial and resource sectors of the market. This sheds additional light on the behaviour and nature of the industrial and resource sector IPOs.

Fourth, this thesis analyses the relationship between IPO activity measures and various economic and stock market variables, thereby exploring the underlying cause for the time series variation in the IPO activity. Ibbotson et al. (1975) and Ibbotson et al. (1994) show the substantial fluctuations in the IPO activity, but these studies do not provide evidence as to the cause of this variation. This thesis extends previous work by employing US IPO data and investigating the extent to which both efficient and inefficient market forces can explain the observed fluctuation in the IPO activity. This helps to provide an understanding of the market for corporate control, the reaction of stock market and its relationship to managerial performance.

Fifth, this thesis examines the interrelationship between the US and Australian IPO markets. Knowledge of the international linkage between national IPO markets is important. First, an analysis of the interrelationship between international IPO activities will add our knowledge on the issue of international diversification. Second, financial managers of private companies are interested in worldwide IPO activity since it influences capital flows. Third, an understanding of financial linkages has implications for policy coordination and regulation.

However, analysis of the interdependence among national IPO markets is currently underdeveloped. This thesis fills this gap.

In summary, the latter four tasks represent an important extension on existing research. This thesis offers new insights into the workings and behaviour of the IPO market. The insights gained in this study point to the influence of financial characteristics on the US and Australian IPO markets, the influence of economic and stock market variables on the hot issue periods and, more generally, the interrelationship between the Australian and US IPO markets. Further, the results have important implications for institutional and retail investors who are interested in IPO behavior during different stages of the cycle. For instance, financial managers need to know how long favourable cyclical conditions for new issues persist because of the relatively long lead times required for an unseasoned issue. Characteristics of IPO cycles should also be of interest to regulators if they impinge on the efficiency and operation of capital markets.

The following section describes the structure of this thesis. A summary for each chapter is provided and the major findings and implications are highlighted.

1.5 Structure of the Thesis

Chapter two provides a review of the theoretical explanations and empirical evidence regarding IPO underpricing. The phenomenon of IPO underpricing is evident in nearly every market, although the degree of underpricing varies across countries. While a number of arguments have been developed to explain IPO underpricing, it appears that no single hypothesis has received overwhelming empirical support. Several unsolved issues exist which are discussed.

A detailed discussion of the definition of hot issue markets and the empirical evidence and theoretical explanations concerning cycles in IPO activity is presented in Chapter three. It is recognised that existing explanations mainly concentrate on supply-side influences of IPOs and appear to be unsatisfactory in fully accounting for the cyclical behaviour of the market. Several economic variables are suggested to be important in explaining the variation in IPO activity which forms an important motivation for the study conducted in Chapter eight.

Chapter four discusses the data used in the empirical tests in the subsequent chapters. It reports the data sources and collection methods for the US and Australian IPO samples. The empirical issues are discussed and assessed. Based on descriptive analysis for both the US and Australian IPO samples, the average monthly initial return in Australia tends to be higher and more volatile in comparison to the US sample. With smaller sizes and greater underpricing, resource sector IPOs represent a relatively large proportion of total IPO issuance in Australia over the period. This feature of the Australian IPO market motivates the separate consideration of industrial and resource sector IPOs in Chapters five and seven.

Construction of various IPO activity measures is described in Chapter five. While two of the measures concern IPO volume, the other two measures concern IPO underpricing. Of note, there appears to be a correlation in the corresponding volume measures between Australia and the USA. In addition, the underpricing series appears to lead the volume series in both markets. These graphical findings motivate a further examination of the interrelationship between the US and Australian IPO activities in Chapter nine and the relationship between the IPO activity measures in Chapters six and seven.

Chapter six focuses on identification of hot and cold IPO periods in the USA. Several research techniques are used, such as visual analysis, the Bry and Boschan method, and a Markov regime switching model. A number of regime switches between hot and cold issue periods are documented across all IPO activity measures. Hot periods are generally characterised by a higher mean and volatility as well as a longer duration when compared to cold periods. Moreover, hot issue periods appear to be related to the general business and stock market conditions. A lead-lag relationship between the measures is identified where IPO underpricing leads IPO volume by up to six months. Overall, the results yield new insights into the IPO market that pave the way for a richer understanding.

The existence of hot and cold issue periods in Australia is documented in Chapter seven. The results suggest the dominance of industrial sector IPOs in Australian new issue market in terms of both number and value of issues. Consistent with the US results, the leading effect of IPO underpricing on IPO volume is documented, especially for industrial sector IPOs. Finally, resource sector IPOs are found to exhibit a substantial influence on the pricing measures of IPO activity. This latter result has implications for further work.

Hypotheses concerning the underlying causes of cycles in the IPO activity with consideration of economic and stock market variables are developed in Chapter eight. Applying both OLS and probit analyses on the US sample, the results support the developed hypotheses. While all economic and stock market variables exhibit roles on the underlying causes of cycles in IPO volume, cycles in IPO underpricing are mainly explained by changes in the stock market and business cycle conditions. There is a similarity between OLS and probit results which confirms the accuracy of the hot and cold issue periods identified earlier.

The interrelationship between the US and Australian IPO markets is examined in Chapter nine. Incorporating the stock market conditions of both markets in Vector Autoregressive analysis, the results reveal the relative dominance of the US market where the frequency of US IPOs leads the frequency of Australian IPOs. In contrast to the finding of strong persistence in all US measures of IPO activity, the feature of persistence is only evident in the number of IPOs in Australia. It appears that Australian IPO underpricing is unpredictable.

Chapter ten provides a summary of the thesis and suggests extensions and directions for future research.

CHAPTER TWO

THE PHENOMENON OF IPO UNDERPRICING

2.1 Introduction

Over the period 1960-1992, there were more than 11,000 IPOs issued in the USA equity market[5] (see Ibbotson et al. 1994) and about 3,000 IPOs in the Australian equity market (Annual Reports of Australian Stock Exchange, 1960-1997). In the large majority of IPOs, the first-day trading price is greater than the prospectus or issue price. This phenomenon is known as underpricing and is generally measured as the closing price of stock on the first trading day divided by the offer price minus unity. IPO underpricing is an empirical phenomenon common to nearly every stock market, both in developed and emerging countries (e.g. Jenkinson and Ljungqvist 1996). A number of theories concerning IPO underpricing have been developed. However, the empirical results of these theories are mixed.

A review of theoretical explanations and empirical evidence regarding IPO underpricing is presented in this chapter. Section two presents empirical evidence related to IPO underpricing in international markets. In Section three, the theoretical explanations related to IPO underpricing are reviewed and are classified into four categories: information asymmetry, investors, the market and institutional framework, and financial intermediaries. Section four concludes the chapter.

[5] This figure includes all exchanges in the USA.

2.2 Empirical Evidence of IPO Underpricing

Considerable research has been conducted in the area of IPO underpricing. The first study to report the phenomenon of IPO underpricing was Reilly and Hatfield (1969). They find an average one-week return of 9% for 53 US IPOs between 1963 and 1965. Neuberger and Hammond (1974) report an average initial return of 17.1% in the first week's trading for 816 IPOs between 1965 and 1969 in the USA. Ibbotson et al. (1988) document an average initial return of 16.4% in the USA for the period of 1960 and 1987. In addition, various studies using US data observe that smaller sized offerings are more underpriced than larger offerings (e.g. Davis and Yeomans 1976; Ritter 1987).

Similar results have been reported in Australia. For instance, Finn and Higham (1988) document an average initial return in excess of the stock market return of 29.2% for Australian industrial and commercial IPOs between 1966 and 1978. Lee et al. (1996a) report an average IPO underpricing of 16.41% using Australian industrial IPO data from 1976 to 1989. In a study of Australian mining sector IPOs during the period 1979 to 1990, How (1996) reports that the average initial return of mining IPOs is 107.12%, which is much higher than that for their industrial companies.

In addition to the finding of underpricing in Australia and the USA, IPO underpricing has also been reported in other markets. Loughran et al. (1994) present evidence on short-run underpricing in fifteen countries though the degree of underpricing varies. They attempt to explain the differences in the national findings and suggest that the differences are partly due to the differences in regulations, contract mechanisms and characteristics of the companies going public. In the next sub-section, further international evidence on IPO underpricing is discussed.

2.2.1 International Evidence on IPO Underpricing

The phenomenon of IPO underpricing is evident in many markets. For instance, Jog and Riding (1987) examine IPOs that went public in Canada between 1971 and 1983 and report that the average degree of underpricing ranges from 9.0% to 11.5% in the first three days from issuance. For 147 IPOs made in Hong Kong during 1986 and 1992, Kang (1995) documents the average and median underpricing as 15.6% and 6.6%, respectively.

Table 2.1 provides international evidence on underpricing across a number of countries. The average first-day initial return is positive in every country. The simple average initial return across all countries is 63.7%.[6] While the lowest underpricing is 4.2% in France, the highest underpricing is 948.6% in the Chinese A-class shares.

From Table 2.1, it appears that average initial returns are generally lower for developed capital markets than for emerging capital markets. The average initial return for emerging markets is 111.6% which is much higher than the average initial return of 19.0% for developed markets. While the range of average initial return for developed markets is between 4.2% and 39.0%, the range of average initial return for emerging markets is between 16.3% and 948.6%.

[6] This figure is distorted by very large underpricing of Chinese A-class shares. Excluding the Chinese A-class shares gives the simple average initial return across all the listed countries of 32.09%.

Table 2.1: International Evidence of IPO Underpricing

Country	Data Period	Average Initial Return (%)	Source
Developed Markets:			
Australia	76-89	11.9	Lee et al. (1996a)
Belgium	84-90	10.1	Rogiers et al. (1993)
Canada	71-92	5.4	Jog and Srivastava (1995)
Finland	84-92	9.6	Keloharju (1993)
France	83-92	4.2	Husson et al. (1989); Leleux et al. (1993)
Germany	78-92	10.9	Ljungqvist (1993)
Italy	85-91	27.1	Cherubini and Ratti (1992)
Japan	70-91	32.5	Jenkinson (1990); Hebner et al. (1993)
Netherlands	82-91	7.2	Wessels (1989)
New Zealand	79-87	28.8	Vos and Cheung (1992)
Spain	85-90	35.0	Rahnema et al. (1992)
Sweden	70-91	39.0	Rydqvist (1993)
Switzerland	83-89	35.8	Kunz and Aggarwal (1994)
U.K.	59-90	12.0	Dimson (1979); Levis (1993)
United States	90-92	15.3	Ibbotson et al. (1994)
Average		*19.0*	
Emerging Markets:			
Brazil	79-90	78.5	Aggarwal et al. (1993)
China A	86-96	948.6	Su and Fleisher (1999)
China B	86-96	37.1	Su and Fleisher (1999)
Chile	82-90	16.3	Aggarwal et al. (1993)
Greece	87-91	48.5	Kazantzis and Levis (1994)
Hong Kong	80-90	17.6	Dawson (1987a)
India	92-93	35.3	Krishnamurti and Kumar (1994)
Korea	80-90	78.1	Kim et al. (1993)
Malaysia	80-91	80.3	Isa (1993)
Mexico	87-90	33.0	Aggarwal et al. (1993)
Portugal	86-87	54.4	Alpalhao (1992)
Singapore	73-92	31.4	Lee et al. (1996b)
Taiwan	71-90	45.0	Chen (1992)
Thailand	88-89	58.1	Wethyavivorn et al. (1991)
Average		*111.6*	
Overall Average		**63.7**	

Note:
1. Table 2.1 is based on Loughran et al. (1994).
2. The classification between developed and emerging markets follows the financial indicator section in *The Economist*.

The literature suggests two major reasons to explain why IPOs of emerging markets are, on average, more underpriced than IPOs of developed markets. The first reason is associated with bureaucratic meddling in emerging markets (Jenkinson and Ljungqvist 1996). For instance, before 1988, Korean IPOs had to be priced at their book values, while offer prices for Taiwanese IPOs were priced using a formula based on the price-earnings ratio prior to 1993. The second reason relates to political interference in the emerging markets where offer prices of IPOs are sometimes set to favour the wealthy and influential. For example, generous allocations of heavily underpriced IPOs have allegedly found their way into the hands of politicians in Malaysia (Jenkinson and Ljungqvist 1996, p. 25).

Research also identifies some distinct financial characteristics related to IPO underpricing. Understanding these characteristics is important since it helps to explain the phenomenon of IPO underpricing. These characteristics are discussed in the next sub-section.

2.2.2 *Financial Characteristics of IPO Underpricing*

2.2.2.1 Price Effect

In an examination of 649 US IPOs between 1975 and 1982, Chalk and Peavy (1987) categorise IPOs by offer price and compare underpricing between the groups.[7] They find that IPOs priced at US$1.00 or less show an average underpricing of

[7] There are five price categories in their study: $0.01-1.00, $1.01-2.00, $2.01-5.00, $5.01-10.00 and over $10.00.

56.43% which is almost 5 times higher than the underpricing for the price group showing the next highest underpricing (11.95%).

More recently, Ibbotson et al. (1994) report that for 2,439 IPOs over 1975-1984 in the USA, the average initial return is 42.8% for IPOs with an offer price less than US$3.00, whereas the average initial return is only 8.6% for IPOs with an offer price of US$3.00 or more. Similar results are also reported in Chalk and Peavy (1987).

2.2.2.2 *Issue Size*

Ritter (1991) studies long run performance of 1,526 US IPOs for the period of 1975-1984. He documents a tendency for smaller offers (measured by issue size) to have the highest adjusted initial returns and the worst aftermarket performance.[8] He argues that this can be explained by the issuers' success in timing the issues and overvaluation by investors.

In a study of IPOs between 1984 and 1988 in the USA, Michaely and Shaw (1994) show that issue size plays an important role in explaining the degree of IPO underpricing. They observe a negative relationship between IPO underpricing and issue size. While the average initial return is 14.72% for the smallest size group, the average initial return is only 5.21% for the largest size group.

Using US data, Ibbotson et al. (1994) also confirm that smaller offerings are more underpriced, on average, than larger offerings.

[8] The adjusted initial return is calculated using the initial return of an IPO on the first trading day minus the return on a matching company at that specific day.

2.2.2.3 *Firm Size*

Using UK data from 1965 to 1971, Davis and Yeomans (1976) test the influence of firm size on IPO underpricing. They find that the firms with net assets of less than £250,000 record average underpricing of 24.9%, which is about three times higher than the average underpricing for firms with net assets exceeding £1,000,000.

2.2.2.4 *Age of the Firm*

The age of the firm refers to the number of years since its incorporation. Ritter (1991) studies long run performance of US IPOs and introduces the age of the firm as a proxy for ex-ante risk, arguing that less established firms are likely to have more uncertain prospects than more established firms. The results of Ritter (1991) show that IPOs with worse long run performances (i.e. lower cumulative abnormal returns) have lower median ages and exhibit higher underpricing, while IPOs with better long run performances (i.e. higher cumulative abnormal returns) have higher median ages and lower underpricing. Ritter interprets these results as evidence of over-optimism where investors are irrationally over optimistic about the future potential of IPOs.

2.2.2.5 *Ownership Structure*

Leland and Pyle (1977) suggest a positive relationship between fractional ownership and firm value. They argue that fractional shares retained by issuers play an important role in determining firm value and can be used by issuers to signal information to the public.

Downes and Heinkel (1982) link the retention of ownership argument to IPO underpricing. They argue that an issuer who retains a high fraction of ownership foregoes the benefits of portfolio diversification. Therefore, high retention of ownership is a proxy for the owner's expectation of aftermarket return available to the IPO investors. Downes and Heinkel (1982) provide empirical support for their argument.

In a study of the Australian new issue market over the period of 1979 to 1989, How and Low (1993) find a positive relationship between firm value and fractional ownership.

2.2.2.6 Industry Effects

Using US data for the period January 1983 through December 1987, Alli et al. (1994) analyse underpricing by separating the IPOs into two groups - financial institutions and non-financial institutions. Their result shows that IPOs of financial institutions are significantly less underpriced than non-financial institutions (5.28% vs. 9.00%).

Ritter (1984b) shows that a hot issue market existed in 1980 in the USA. He argues that this hot issue market arose from natural resource issues since only natural resource issues appeared excessively underpriced during this period. For non-natural resource issues, an average initial return of 21.0% is observed in the 1980 hot issue period compared to an average initial return of 110.9% during the same period for natural resource issues.[9]

[9] This feature is also discussed in detail in Chapter three of this thesis.

2.2.2.7 Subsequent Issues

The literature concerning subsequent equity issues appears to be inconsistent. For example, Jegadeesh et al. (1993) examine firm-commitment IPOs from 1980 through 1986 in the USA. Their results show that the IPOs with greater underpricing are more likely to issue seasoned offerings within three years of the IPO and, on average, make larger seasoned offerings. Michaely and Shaw (1994) show an opposing result using US data between 1984 and 1988. They show that firms that experience a high degree of IPO underpricing tend to return to the seasoned offering market less frequently. In a study of US IPOs during 1980-1983, James (1992) documents that the average IPO underpricing for firms that do not make subsequent offers is not statistically different to the average IPO underpricing for firms that make subsequent offers.

2.2.3 Summary

Empirical evidence suggests that underpricing of common stock IPOs is an empirical regularity that exists in nearly every market, although the degree of underpricing varies across countries. A number of financial characteristics related to IPO underpricing have also been observed and appear to play a role in explaining IPO underpricing. A number of theories have attempted to explain this anomaly by focusing on factors, such as, underwriter reputation, information asymmetry between investors and companies, signalling hypothesis and so on. These explanations are reviewed in the next section together with the potential weaknesses related to these hypotheses.

2.3 Reasons for IPO Underpricing

The underpricing of IPOs has attracted much research in the last two decades and some models have been developed to explain this phenomenon. Ibbotson (1975) offers basic insight into the existence of IPO underpricing:

"*...either the offering price is set too low or the investors systematically overvalue new issues at the end of the first month seasoning*." (p. 262)

Alternatively, Miller (1977) argues that the offer prices of IPOs are set to be consistent with underlying economic values of issuing companies. The large excess returns on IPOs are due to speculative behaviour of investors, especially those investors who cannot obtain allocations of oversubscribed issues at the offer prices.

The above suggests that explanations of IPO underpricing can be grouped in three ways. First, offer prices of IPOs may be set too low by issuers. For instance, IPO underpricing acts as a signal of quality of the firm (e.g. Allen and Faulhaber 1989). Second, investors may be over-optimistic about IPOs. This may be explained by the existence of information asymmetry between issuers, underwriters and investors and may be also due to the difficulty in pricing an IPO, since IPO trading history is generally not available, or limited, especially for small issues. Third, offer prices of IPOs may be set correctly but the large initial returns on IPOs are due to speculative appetites of investors.

In the past, most explanations have focused on the first category and implicitly assumed an efficient market in which investors apply rational strategies. However, the capital market exhibits at least some degree of irrationality and inefficiency. For instance, there is evidence that investors are willing to overpay at the time of the IPO (e.g. Ritter 1991; Loughran and Ritter 1995).

In the next sub-section, I show that the existing explanations focus on various aspects of the relations between investors, issuers and the investment bankers responsible for the issues.

2.3.1 Hypotheses Related to Information Asymmetry

Information asymmetry refers to the fact that one or more parties can access information about a specific company that is not available to others. Since the issuer and underwriters have more information about the company than outsiders do, this suggests that the problem of information asymmetry may exist in the IPO market. The theory of information asymmetry has been applied widely to explain IPO underpricing. For instance, Baron (1982) develops a theoretical model to explain the existence of IPO underpricing by assuming that the investment banker is better informed about the capital market than the issuer. Other hypotheses, such as the 'winner's curse' hypothesis (Rock 1986), and the signalling hypothesis (Welch 1989; Allen and Faulhaber 1989; Grinblatt and Hwang 1989), are also related to the concept of information asymmetry.

2.3.1.1 Asymmetric Information between Issuer and Underwriter

Baron (1982) models underpricing based on the assumption that information asymmetry exists between the issuer and underwriter. In his model, Baron assumes that the underwriter is better informed about the capital market conditions than is the issuer, and the issuer cannot observe the distribution effort expended by the underwriter. Under such a situation, the issuer delegates the pricing decision to the underwriter and the underwriter takes advantage of their superior information about the market by underpricing the issue. This allows the underwriter to expend less marketing effort and ingratiate themselves with the investors. Therefore, Baron argues that the discount on an IPO is an increasing function of uncertainty about the market demand of an issue faced by the issuer. The higher the uncertainty about the market price for the company's shares, the higher the expected underpricing.

Muscarella and Vetsuypens (1989b) test Baron's model by investigating the IPOs of 38 investment banks where these banks underwrite their own issues. Since investment banks underwrite their own issues, there is no information asymmetry problem. Thus, based on Baron's model, there should not be any underpricing of these issues. The results are inconsistent with Baron's model. Muscarella and Vetsuypens find that investment banks underprice themselves as much as other IPOs of similar size. Cheung and Krinsky (1994) also fail to support Baron's model using Canadian data.

2.3.1.2 Winner's Curse

The best-known asymmetric information model of underpricing is developed by Rock (1986). This model relies on information asymmetry between informed and uninformed investors where informed investors have an information advantage relative to uninformed investors. Consequently, informed investors will only bid for shares when an issue is underpriced. Conversely, uninformed investors have no information advantage about an issue and they will bid for all new issues. As a result, they are more likely to receive a full allocation of an issue if the issue is overpriced and only a fraction of an issue if it is underpriced. Hence, uninformed investors face a 'winner's curse': if they get all of the shares they want, it is because informed investors do not want these shares. As a result, firms are forced to underprice IPOs in order to compensate uniformed investors for this adverse selection problem since uninformed investors will only submit purchase orders when IPOs are sufficiently underpriced. A prediction of Rock's model is that the average initial return for uninformed investors should be equal to the risk-free rate.

In a study by Koh and Walter (1989), the results from Singapore IPOs over the period 1973-1977 support Rock's argument. They show that the initial returns for uninformed investors are not statistically different from the risk-free rate. Lee et al. (1996b) also support the winner's curse hypothesis using Singapore data for the period 1973 to 1992.

There is a potential problem with the assumption of the winner's curse hypothesis. As indicated by Gordon and Jin (1993), there is no evidence regarding the existence of informed and uninformed investors. It is hard to determine why some investors are better informed than others (Gordon and Jin 1993, p. 142). Keasey and Short (1992) also question the above assumption used in Rock (1986) and cast doubt on the validity of existing empirical tests which support this model. Furthermore, they claim that Rock's model is largely untestable.

An alternative model is based on the 'cascade hypothesis' developed by Welch (1992) where later investors rely at least in part on the purchasing decisions of earlier investors. It appears that some investors pay attention to the purchase decisions of earlier investors and place less weight on their own information, even if their own information is favourable. Hence, the distinction between informed and uninformed investors may be less important than suggested by Rock (1986).

2.3.1.3 Signalling Hypothesis

Three studies apply a similar signalling model to explain IPO underpricing. It is argued that issuers follow a two-stage financing program[10] (Welch 1989; Allen and Faulhaber 1989; Grinblatt and Hwang 1989). They argue that underpricing is, in fact, an instrument adopted by issuers to reveal corporation information to investors. In these models, issuers are assumed to have private information concerning the quality of their firm and can distinguish their own firm as high- or low-value based on expected future operating performance. Hence, both low- and high-value firms know more about their true value than outsiders.[11]

[10] The signalling hypothesis assumes that issuers sell a fraction of their firms through IPOs and the remainder through seasoned offerings.

[11] High-value and low-value firms are distinguished by their expected future operating performance (e.g. profitability of their operations and their abilities in paying higher dividends).

High-value firms may choose to underprice their issues to signal to the market that they are high-value firms since they are confident about their future operational performance and expect to benefit sufficiently from higher prices later when making seasoned offerings. Therefore, the high-value firms have no incentive to avoid underpricing. Low-value firms cannot offer this tradeoff because they do not expect the same (relative) level of future cashflows and dividends relative to high-value firms. The implication is that the firms with higher IPO underpricing tend to return to the seasoned offering market more frequently and are more likely to exhibit strong future earnings performance and higher dividends.

Welch (1989) presents evidence that the firms with higher IPO underpricing conduct seasoned equity issues more frequently than a random sample of US public firms. However, Michaely and Shaw (1994) test the signalling hypothesis using US data for the period of 1984 to 1988. Their results reveal that firms with higher underpricing return to the seasoned offering market less frequently and pay lower dividends compared to firms with lower initial underpricing. Other studies, including Garfinkel (1993), Jegadeesh et al. (1993), Jain and Kini (1994) and Jenkinson (1990), all find that the hypothesised relationship between initial returns and subsequent seasoned offerings is not present. This casts doubt on the relevance of signalling as a reason for IPO underpricing.

The assumption underlying the signalling hypothesis, that issuers are better informed about their companies than investors or underwriter, needs to be taken with caution. IPOs are sold to the public and the market decides the clearing price of the IPO. The offer prices of IPOs set by the issuers might be viewed to be over-priced by the market if asymmetric information exists, even when the issuers have already intentionally priced their issues at a discount. Also, the signalling hypothesis assumes that issuers follow two-stage financing, that is, selling a fraction of the firm through the IPO and then the remainder through seasoned offerings. This might not be the case in reality.

2.3.2 *Hypotheses Related to Investors*

Since underpricing is likely to arise from the interaction of investor demand and firm supply of stock, the behavior of investors might play an important role in explaining the phenomenon of IPO underpricing. In this sub-section, theoretical models related to behavior of investors are reviewed. The cascade effect hypothesis developed by Welch (1992) is first introduced and is followed by Miller (1977)'s speculative bubble hypothesis.

2.3.2.1 Cascade Effect

In his model, Welch (1992) argues that the IPO market is subject to cascade effects. When IPO shares are sold sequentially, later potential investors can learn from the purchasing decisions of earlier investors (Welch 1992, p. 695). An individual can interpret the purchase decisions made by earlier investors as an indication of information advantage that these investors have about the offering. The investor might decide not to buy if no one else wants to buy, even if he/she has favourable information about the offer on hand. To prevent this from happening, an issuer may underprice an issue to induce the first few investors to buy which in turn induces a cascade effect. The implication is that later investors rely, at least in part, on the purchasing decisions of earlier investors and place less weight on their own information.

There appears to be no empirical test of this model to date though this may be due to the difficulty encountered in obtaining the necessary data.

2.3.2.2 Speculative Bubble

Miller (1977) argues that large excess returns of IPOs can be explained by the speculative appetites of investors in the secondary market when they do not obtain allocations of oversubscribed issues in the primary market. Under this hypothesis, the aftermarket price of an IPO will be bid up well above its intrinsic value temporarily due to the speculation in the aftermarket. The positive excess return should disappear as the bubble bursts sometime later.

Using a sample of natural resources issues in the period 1979-1982, Ritter (1984b) concludes that there is no evidence to support this hypothesis, even using highly speculative small IPOs. He reports that the aftermarket price movements of those natural resources with extreme high underpricing appear to coincide with movements of a national index of natural resources in the stock market. He finds no evidence of a 'burst bubble' in the IPO activity during the period. Lee et al. (1996a), who study post-listing returns of Australian IPOs, also reject this hypothesis.

2.3.3 *Hypotheses related to the Market and Institutional Framework*

Two hypotheses related to the market and institutional framework are discussed in this sub-section. The first is the lawsuit avoidance hypothesis developed by Tinic (1998) who argues that IPO underpricing may act as insurance against possible legal liability on underwriters and issuers. This is followed by the market incompleteness hypothesis developed by Mauer and Senbet (1992).

2.3.3.1 *Lawsuit Avoidance Hypothesis*

Disclosure requirements in many markets expose underwriters, accountants and issuers to considerable litigation risk where shareholders can prosecute them for false or mis-stated information in the prospectus. Tinic (1988) argues that IPO underpricing may act as insurance against possible legal liabilities of underwriter and issuer as well as potential damage to the reputation of underwriter. In addition to costly lawsuits, issuers may face a higher cost of capital in future equity issues and litigation-prone investment banks may lose the confidence of their regular clients. The higher the offer price for an IPO, the higher the possibility that the IPO is overpriced. Consequently, the more likely is a future lawsuit. To protect against any potential lawsuit, the issuer and underwriter underprice the IPO.

Tinic (1998) examines his hypothesis using IPOs before and after the US *Security Act* of 1933 and provides empirical support for the hypothesis. He finds that

IPOs are more underpriced after 1933. Further, he observes that prestigious underwriters avoid underwriting small and speculative firms.[12]

While Tinic (1988) provides empirical support for his model, Drake and Vetsuypens (1993) conclude that the hypothesis is not a likely explanation for the observed level of IPO underpricing since there is no evidence that underpricing reduces the probability of a lawsuit. They show that underpricing of firms that are subsequently sued is not significantly different from the underpricing of those firms that are not sued. International evidence is also not supportive. For instance, Keloharju (1993) rejects the hypothesis using Finnish data and Ljunqvist (1993) finds that there is underpricing in countries without securities lawsuits.

2.3.3.2 Market Incompleteness Hypothesis

Mauer and Senbet (1992) present a model where IPO pricing is modeled in two distinct markets, the primary market and the broader capital market (or secondary market). They argue that IPO underpricing is a consequence of IPOs being traded in two separate markets. IPOs are generally newly established firms with little or no operating histories and offer prices of IPOs are set in the primary market. Subsequent to the IPO, the shares are traded in the relatively larger and more centralised secondary market. Since there is some market segmentation between the primary and the secondary market, IPO investors demand a risk premium in the form of

[12] In the USA, the *Securities Act* of 1933 identifies that the parties may be subject to civil liabilities for false or inadequate information presented in the registration statement. However, prior to 1933, issuers and underwriters faced little litigation risk.

underpricing to compensate them for bearing diversification risk as perfect substitutes for IPOs in the secondary market are not generally available.

In a test using US data over the period 1977-1984, Mauer and Senbet (1992) provide supportive evidence for the hypothesis. Muscarella and Vetsuypens (1989a) study the IPOs of reverse leverage buyouts and find these IPOs are significantly less underpriced than typical IPOs.[13]

2.3.4 Hypotheses Related to Financial Intermediaries

Underwriters play an important role in the process of IPOs since they market the shares for issuers. The relationship between underwriters and IPO underpricing is well documented in the literature. In this sub-section, five hypotheses related to underwriters are discussed.

2.3.4.1 Asymmetry Payoffs to Underwriters

A popular explanation for IPO underpricing is the asymmetric payoff to underwriters (Affleck-Graves and Miller 1989). This hypothesis is based on the regulations and procedures governing IPOs. IPOs must be issued at a fixed price. If an issue is fairly priced or underpriced, the underwriter will receive a fixed income. However, the underwriter will bear all the losses if the issue is overpriced and subsequently fails. Therefore, the underwriter desires to underprice the new issue in

[13] Leverage buyouts are transactions in which investors make a public firm private using borrowed funds. However, some companies that have been made private through leverage buyouts decide to reconvert to public ownership. These transactions are called 'reverse leverage buyouts' (RLBO). A significant difference between IPOs of RLBOs and common IPOs is the availability of trading history as the trading history of an RLBO is generally available.

order to reduce the underwriting risk. In other words, underpricing acts as a tool to reduce the probability of an unsuccessful issue and the associated losses for the underwriter.

This hypothesis does not appear to be very successful in explaining IPO underpricing. Chalk and Peavy (1987) argue that if IPO underpricing is driven by the underwriter's desire to reduce their risk exposure, IPO underpricing is only expected on a 'firm commitment' contract. IPO underpricing should not exist for IPOs issued under a 'best efforts' contract since the underwriter does not need to handle unsold shares in the event of an unsuccessful issue. Their empirical evidence reveals that best efforts contracts tend to be more underpriced than firm commitment contracts. However, it should be noted that best efforts contracts are normally used by small speculative firms (Loughran et al. 1994). As these, firms are generally riskier, this additional risk may provide an explanation for higher underpricing on best efforts contracts.

It is also worthwhile to mention that if underwriting a new issue is risky and costly for an underwriter, the underwriter can price this risk into the underwriting fee.

2.3.4.2 Dynamic Information Acquisition

Based on the assumption that both the firm and underwriter may not know the market valuation of the new issue precisely, Benveniste and Spindt (1989) develop a model in which investment bankers underprice IPOs to induce regular investors to reveal information during the pre-selling period.

In this model, a problem faced by the underwriter is the collection of information to help price a new issue. However, investors have no incentive to reveal their personal information before the issue. To induce investors to reveal truthful information about the issue, the underwriter must underprice the issue to compensate these investors for revealing their private information. An implication is that, IPOs whose offer prices are finally revised upward (relative to the preliminary offer prices contained in their initial prospectuses) will be relatively more underpriced.

In a study of US firm commitment IPOs from 1983 to 1987, Hanley (1993) provides evidence to support the hypothesis of dynamic information acquisition. She observes that issues, where final offer prices exceed the range of offer prices in the preliminary prospectus, exhibit greater underpricing and the number of shares issued is more likely to be increased. This result suggests that underwriters prefer to compensate investors who truthfully reveal their private information through allocation of a smaller number of highly underpriced shares.

Loughran and Ritter (1999) provide further evidence and show that IPOs with the final offer price below the minimum of the file price range have average first-day returns of only 4%, whereas those that are priced above the maximum of the file price range have average first-day returns of 32% (Loughran and Ritter 1999, p. 3).

2.3.4.3 Monopsony Power of Underwriters

West (1965) studies the offerings of unseasoned municipal bonds in the USA and concludes that underwriting industry is, to a large degree, a monopsonistic industry in the USA. There is evidence that underwriters with good reputations generally have no incentive to underwrite small, speculative and start-up firms due to the possibility of adverse price movements which destroy their reputation (Booth and Smith 1986; Ritter 1984b; Tinic 1988; Wolfe et al. 1994). This forces small firms to be underwritten by small regional underwriters who have greater bargaining power over the issuers.

This argument is supported by evidence that IPOs of small firms exhibit higher underpricing relative to underpricing of large firms' IPOs. Considering the evidence of the US IPO market, Ritter (1984b) and Tinic (1988) claim that underpricing may be the result of the monopsony power of the investment bankers in underwriting the IPOs of small firms.

Although the monopsony hypothesis has some success in explaining IPO underpricing, there are some problems as indicated by Tinic (1988). First, it does not explain why prestigious underwriters are reluctant to underwrite some IPOs. Second, increased competition for new business in the underwriting industry should eliminate monopsony power. Also, there is evidence that not every small firm IPO is underpriced (Gordon and Jin 1993). Third, small firms should learn from the experience of previous issuers and search for investment banks who can price their IPOs more precisely. As a result, the magnitude of underpricing of small IPOs should decrease over time. This latter feature is not observed in practice.

2.3.4.4 *Reputation Effect of Underwriters*

Titman and Trueman (1986) develop a model wherein issuers have an incentive to signal their firm value through the quality of the investment bankers or auditors selected for the IPO. However, their model does not consider the underpricing phenomenon. Carter and Manaster (1990) extend the work of Titman and Trueman (1986) by applying the model to explain IPO underpricing. They show that IPO underpricing is quite costly to issuers and hence an issuer with low risk tends to employ a prestigious underwriter to convey their low risk to the market.[14] Conversely, underwriters with a good reputation will only market low risk IPOs in order to protect their reputation. This, in turn, reduces the uncertainty of aftermarket prices of IPOs and information asymmetry between informed and uninformed investors. Consequently, low initial returns are expected for low risk IPOs.

There are a number of studies that support the reputation effect hypothesis (e.g. Balvers et al. 1988; Carter and Manaster 1990; Michaely and Shaw 1994; Carter et al. 1998). They all find a negative relation between underwriter reputation and IPO underpricing in the US market.

A major issue in this hypothesis is how to measure the underwriter's reputation. There are generally three ways to measure the reputation of an underwriter. Carter and Manaster (1990) measure the underwriter's relative placement in the stock offering 'tombstone' announcement as underwriter reputation.[15] Megginson and Weiss (1991) measure underwriter reputation using the relative market share of the underwriter. Johnson and Miller (1988) use a modified form of the Carter-Manaster measure and classify underwriters into four categories with different rates of ranking. The underwriters who fall into 'bulge bracket' are defined as the most prestigious underwriters and a rank of 3 is assigned to them. While a rank

[14] Risk defined here is the uncertainty regarding the aftermarket price of the IPO.
[15] A tombstone announcement is a listing of a pending public offering.

of 2 is assigned to those underwriters considered part of the 'major bracket', a rank of 1 is assigned to underwriters in the 'sub-major bracket'. All other underwriters are assigned a rank of zero.[16] In a comparative evaluation of these three measures of underwriter reputation, Carter et al. (1998) find that the Carter-Manaster measure is the most significant in the context of initial returns and long run performance of IPOs.

2.3.4.5 Aftermarket Support

Nearly all of the above hypotheses assume that a deliberate decision is made by either the issuer or the underwriter to set the offer price below the true value of an IPO. If so, the distribution of a sample of IPO initial returns could be normally distributed with a positive mean. However, initial returns of IPOs typically peak sharply at zero and are highly skewed based on empirical evidence.[17] Ruud (1993) challenges the existing hypotheses of IPO underpricing and argues that the apparent underpricing may be largely due to underwriter price support in the aftermarket. She states that underwriters typically price IPOs at their expected market value. In the aftermarket trading, underwriters support those IPOs whose prices fall below the offer prices. When the price of an IPO is actively supported in the aftermarket, the trading

[16] The 'bulge bracket' is a group of investment banks that have occupied a leading role in high-quality securities underwriting in the year since the US *Securities Act* of 1933. The firms in the 'Major bracket' generally are allotted smaller portions in the underwriting syndicates than those in the bulge group but still wield considerable powers in the US market. The sub-major group consists of firms that are considered to be contenders for membership in the major bracket. They are often allocated a major bracket sized share of the offering but, on average, their underwriting proportions are smaller than either of the groups above them (Carter et al. 1998, p. 289).

[17] This implies that initial returns of IPOs may be drawn from at least two populations rather than a symmetric distribution with a positive mean.

price is allowed to rise but is prevented from falling significantly until the IPO is fully subscribed.[18]

A number of studies support the aftermarket hypothesis (Ruud 1993; Hanley et al. 1993; Schultz and Zaman 1994; Asquith et al. 1998). For instance, Asquith et al. (1998) find that the cross-sectional distribution of one-day IPO returns is modeled better as a mixture of two distributions, with one being consistent with underpricing and another consistent with price stabilisation. Moreover, such mixed distributions in IPO returns persist for up to four weeks.

Nevertheless, there are some potential problems with this hypothesis. First, it is based on the assumption that new issues cannot be fully allocated and this forces the underwriter to stabilise the price until the issue is fully sold. This is a simplification and does not have to be the case in reality. Second, price stabilisation could impose a financial burden on the underwriter. To stabilise price may require a large amount of money. Is it really worthwhile for an underwriter to support the price of an issue in the aftermarket?[19] Third, the process of price stabilisation may be true in the USA but this needs not to be the case in other countries, whereas IPO underpricing is found to be a worldwide phenomenon.

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[18] Aftermarket price support of an IPO is an effort by the underwriter to bid up the aftermarket price of the IPO when the market price would decline without intervention. There are a number of motives for aftermarket support. If the aftermarket price of an IPO falls below the offer price, the underwriter might have a problem selling the issue since investors can buy it in the aftermarket rather than in the IPO. Also, such price support prevents the cascade effect of Welch (1992). Moreover, aftermarket support minimises legal liability (Schultz and Zaman 1994).

[19] However, the process of price stabilisation may be an agreement between an issuer and an underwriter and the underwriter may charge more for doing so.

2.4 Summary and Discussion

A number of arguments have been put forward in an endeavor to explain IPO underpricing. Four categories are identified based on intuitive features, being information asymmetry, investors, the market and institutional framework, and the impact of financial intermediates. A number of studies use different methodologies and datasets to examine these theories and the results are often inconsistent. Although these studies appear to have some success in explaining IPO underpricing, no single hypothesis has received overwhelming empirical support. In general, these hypotheses are not mutually exclusive and hence, any one theory may be important for some IPOs, but not all IPOs.

Past studies reveal some major questions. First, as indicated in Ibbotson and Ritter (1995), many of the above explanations for IPO underpricing can be critised on the grounds of extreme assumptions that are made or the convoluted stories involved (Ibbotson and Ritter 1995, p. 1001). For instance, the signalling hypothesis assumes that issuers follow a two-stage financing program, such that a fraction of the firm is sold through the IPO and the reminder through seasoned offerings. This might not necessarily be the case. Further, Keasey and Short (1992) evaluate Rock's model and show that this model rests on a number of conflicting assumptions and a form of analysis which is in contradiction with its core hypothesis.

Second, some models are difficult to examine in practice. For instance, the cascade hypothesis, developed by Welch (1992), is difficult to test because of the difficulty of obtaining information on individual investors. Further, Keasey and Short (1992) claim that the propositions in Rock's model are largely untestable.

Third, most theoretical models assume that early IPO returns are drawn from a common distribution. This assumption is questionable given the evidence of the aftermarket price support hypothesis where a mixed distribution of the initial returns is supported (Asquith et al. 1998).

Fourth, differences in evidence may be attributed to different methodologies and datasets that have been employed by various researchers. Carter et al. (1998), for example, provide a comparative evaluation of three existing measures of underwriter reputation in the context of initial returns and three-year performance of IPOs. They find that only the Carter-Manaster measure remains significant when all three measures are evaluated simultaneously.

Fifth, most previous studies consider the statistical significance of the results, but ignore the economic significance of the results and their implications. The magnitude of parameter values should also be considered in the analysis. For instance, Jegadeesh et al. (1993) test the signalling hypothesis and provide evidence that the greater the level of IPO underpricing, the more likely the firm is to issue seasoned equity and, on average, make larger seasoned offerings. However, they also observe that 15.6% of the firms in the lowest underpricing group (-6.4% on average) issue seasoned offerings, whereas 23.9% of the firms in the highest underpricing group (42.9% on average) return to the seasoned offering market. This finding leads them to argue that the relation between IPO underpricing and subsequent seasoned offerings is rather weak from an economic perspective and hence question the explanatory power of the signalling hypothesis.

Finally, almost all explanations are developed based on the US institutional and financial framework. To date, there is still no single widely accepted and supported model that can successfully explain the phenomenon of IPO underpricing. It is likely that a combination of explanations is at work with different models exhibiting greater explanatory power in specific circumstances.

CHAPTER THREE

THE CYCLICAL BEHAVIOUR OF THE IPO MARKET

3.1 Introduction

Hot issue IPO markets were first identified by Ibbotson and Jaffe (1975). They defined a hot issue market as a market with a considerable number of extremely underpriced issues. Recently, researchers have examined average monthly underpricing of IPOs as well as the monthly volume of new issues when investigating the hot issue market (e.g. Ritter 1984b; Ibbotson et al. 1994; Ritter 1998; Helwege and Liang 1996a). An operational definition of a hot issue market may be characterised by an increase in firms making unseasoned issues, a high degree of underpricing, and frequent oversubscription of offerings (Ritter 1984b; Helwege and Liang 1996a). The existence of cycles in the IPO activity implies variation in market conditions. Such variation raises important questions for managers as to whether and when new equity should be raised through an IPO. There are also issues for investors to consider relating to timing and expected returns. Further, there are implications that arise for regulators when considering the impact of regulatory decisions on market conditions.

Recent evidence from the USA has confirmed that hot issue IPO markets exist with underpricing appearing to follow cycles (e.g. Ritter 1984b; Helwege and Liang 1996a; James and Kieschnick 1997). Hot issue IPO markets are also evident in other countries. For instance, hot issue markets were observed in the UK and

South Korea in the late 1980s and in Germany during 1982-1983 and 1985-1986 (see Ritter 1998).

The level of the IPO market activity has traditionally been viewed in terms of two measures. First, a pricing measure such as the average level of underpricing (e.g. Ibbotson and Jaffe 1975; Ritter 1984b). Second, a volume measure such as the number of IPO issues (e.g. Loughran and Ritter 1995).

In this chapter, the empirical evidence concerning cycles in the IPO activity is reviewed and explanations for the existence of these hot periods are discussed.

3.2 Empirical Evidence

In this section, the empirical evidence relating to cycles in the IPO activity is classified into three categories. The first two categories concern IPO underpricing and IPO volume. The third category concerns the financial characteristics of IPOs in hot issue periods.

3.2.1 Measuring IPO Activity in Terms of IPO Underpricing

Ibbotson and Jaffe (1975) were among the first to document that the degree of IPO underpricing is cyclical and concentrated in particular periods in the US market. At the beginning and end of the 1960s (1959-1961 and 1968-1969), the IPO markets were 'hot' in the sense that significant underpricing was observed. For instance, the highest IPO underpricing[20] during the hot periods was more than 100% in contrast to the average of 12.64% across the whole period (1960-1970).

[20] IPO underpricing in Ibbotson and Jaffe (1975) is defined as the difference between the first month's return on an IPO and the return on the market (S&P500) index.

Using data for the USA, Ritter (1984b) shows that there was also a hot issue market in 1980. He argues that the 1980 hot issue market arose from natural resource issues since only natural resource issues appeared excessively underpriced during this period. For non-natural resource issues, an average initial return of 21.0% was observed during the hot issue period of 1980 compared to a similar 15.8% during the 'cold' issue period. However, for natural resource issues, a hot issue market is apparent. The average initial return of natural resources was 110.9% during the hot issue period of 1980 compared to only 18.3% during the cold issue period. By applying a model developed by Rock (1986), Ritter (1984b) suggests a changing risk composition hypothesis to explain the 1980 hot issue market. He argues that if high risk IPOs represent an unusually large proportion of offerings in some specific periods, high average IPO underpricing should be observed in these periods.

With confirmation of hot issue markets in 1960s and the beginning of the 1980s,[21] Ibbotson et al. (1994) observe the existence of hot issue markets in the late 1980s and at the beginning of the 1990s. The hot issue market in the late 1980s in the USA appears to coincide with the hot issue markets in the UK and South Korea over the same period.[22]

3.2.2 Measuring IPO Activity in Terms of IPO volume

Ibbotson et al. (1994) describe the level of underpricing and volume in terms of persistent processes where current period value is a predictor of next period value. Specifically, they find that the current month's average IPO

[21] See Ibbotson and Jaffe (1975) and Ritter (1984b).
[22] IPO underpricing is defined as equally-weighted average initial return in Ibbotson et al. (1994).

underpricing is a predictor of the next month's average initial return, as shown by the high first-order autocorrelation of monthly average initial returns of 0.66. Moreover, the persistence of IPO volume from month to month is even stronger than observed in IPO underpricing with a first-order autocorrelation of 0.89 for volume. Ibbotson et al. (1994) suggest these results are somewhat related to periodic overoptimism by investors.

Loughran et al. (1994) evaluate the timing on international IPO markets. They find that in 14 of the 15 countries studied, there is a tendency for high volume periods ('hot' years are measured in terms of number of IPOs) to be associated with lower long-run returns of IPOs. A positive relationship between the inflation-adjusted level of stock markets and IPO volume is also reported in their study.[23]

Choe et al. (1993) document that the frequency of seasoned offerings rises in economic upturns in the US market over 1971 to 1991. They identify a positive relationship between equity issue volume and economic activity (as measured by business cycle variables).

3.2.3 Financial Characteristics of IPOs During Hot Issue Periods

3.2.3.1 Firm Specific Characteristics

<u>Quality of the Firm</u>

The empirical evidence concerning the quality of firms that issue equity in hot and cold periods is mixed. Bayless and Chaplinsky (1996) find empirical

[23] It is interesting to note that the Australian IPO market is included in the study of Loughran et al. (1994) though the data is restricted to industrial sector IPOs. The correlation between IPO volume per year and the stock market index in Australia is 0.54.

support for their asymmetric information theory that issuers of seasoned equity in hot markets are normally higher quality firms.[24] However, studies of the long-run performance of IPOs and seasoned offerings suggest that equity issuers are inferior firms in the hot market since the equities issued during hot periods experience significantly greater underperformance compared to equities issued during other periods (e.g. Ritter 1991; Loughran and Ritter 1995; Loughran et al. 1994).

Operating Performance of the Issuer

Although they do not study hot and cold markets specifically, the results of Jain and Kini (1994) indicate that IPO issuers time their offerings to coincide with their peak operating performance as measured by the IPO firm's operating cash flows. Once the shares are made public, there is evidence of sharp declines in firm operating performance. This finding is supported by Mikkelson et al. (1997) who use a longer sample period of up to 10 years after the initial listing.

3.2.3.2 Economic Conditions

Business Cycles

Choe et al. (1993) develop an adverse selection model where firms choose between issuing debt and equity across business cycle expansions and contractions. They observe that, in general, firms issue stock when it is believed to

[24] In the study of Bayless and Chaplinsky (1996), the hot issue period is defined using aggregate equity issue volume per year and quality of firm is proxied using free cash flows, return on assets, cash on hand and capital expenditure for a period two years before to two years after the issue.

be overvalued and avoid issuing when it is believed to be undervalued. The studies in seasoned equity offerings by Lucas and McDonald (1990), Taggart (1977), Marsh (1982) and Smith (1977) provide theoretical and empirical support for the above argument that equity issues tend to follow periods of sustained stock price increases.

Stock Market Level

Taggart (1977), Marsh (1982) and Brealey et al. (1976) all indicate that equity issues tend to follow market rises in the USA. Loughran et al. (1994) observe that IPO volume is positively correlated with the inflation adjusted stock market level in 14 out of 15 international markets. They argue that IPOs are timed to benefit from periods of favourable investor sentiment and overvaluation. This implies that rises in the stock market level are associated with IPO market activity. In addition, Rees (1997) provides evidence that the stock market level predicts the value and volume of IPOs in the UK.

An obvious weakness in the above studies is that they only consider the impact of current level of the stock market on IPO activity. Of note, IPO issuers cannot generally respond instantaneously to market conditions since there is a 3-6 month lead needed to undertake the various activities required to fulfil the legal requirements and promote the issue (Lipman 1997). Hence, there is a delay between the manager's decision to commence the issue and the resultant listing of the stock. When managers make the decision to issue an IPO, they have only the available information set at that time and need to predict the IPO market conditions at the expected listing date. Hence, any study concerning the relationship between equity issues and market conditions should consider leading market conditions.

Stock Market Volatility

When stock market volatility increases, the risk of failure for an equity offering also increases. In order to cover expected losses, underwriters must charge higher fees (e.g. Bae and Levy 1990; Handley 1995; Marsh 1980). This shift in the relative costs of equity offerings during increased stock market volatility decreases the incentive of firms in going public. As a result, the number of issues falls (Choe et al. 1993). Schwert (1989) documents that stock price volatility varies across the business cycle, increasing during recessions and decreasing during expansions. After controlling for the business cycle effect, the empirical results of Choe et al. (1993) provide evidence of a negative relationship between the frequency of seasoned issues and stock market volatility.

Although Choe et al. (1993) provide supportive evidence on the relationship between the frequency of seasoned issues and stock market volatility, this argument appears to be somewhat weak. Since underwriting fees represent only a small proportion of total funds raised by companies,[25] companies also consider other factors when making the IPO decision, such as current and expected future economic conditions. Therefore, changes in underwriting fees are unlikely to have a significant impact on the IPO market unless changes in underwriting fees are unusually large.

[25] Based on Ritter (1998), the average gross spreads of an issue represent 7.31% of total proceeds (including management fee, underwriting fee and selling concession).

Interest Rates

The interest rate effect on the equity issue market is linked to the bond market. White (1974) and Taggart (1977) provide evidence that both the level and structure of interest rates are important determinants of debt issues. Debt is typically issued when interest rates are low since it attracts relatively high prices. Increased debt financing reflects decreased equity financing since debt financing can be seen as a substitute for equity financing. Therefore, a positive correlation between interest rates and the number of equity offerings is expected (Choe et al. 1993).

Further, Donaldson (1961) observes that companies tend to follow a pecking order of financing sources. That is, companies first consider internal finance, then consider external funding through borrowing and finally consider equity financing (also see Myers and Majluf 1984). Since decreases in interest rates lead to lower borrowing costs, companies may raise funds through borrowings or corporate debt issues, if internal finance is too costly. Hence, low interest rate regimes lead to fewer equity issues resulting in a decrease in the supply of IPOs.

In their study, Choe et al. (1993) find that interest rate changes provide little explanatory power in explaining the frequency of seasoned equity offerings.

Industry Related Factors

Ritter (1984b) provides evidence that the hot market of 1980 may have been driven by natural resource IPOs. Ritter's finding is theoretically supported by Allen and Faulhaber (1989) who develop a signalling model to explain IPO underpricing. They argue that hot issue markets may be industry-specific. In support, they note that that the 1980 hot issue market arose from natural resource issues associated with the exogenous shock of the 1979 OPEC oil crisis.

The 1979 oil crisis resulted in substantial increases in prices for petroleum products worldwide. Investors in this situation may have been over optimistic about the growth potential of natural resource firms inducing high demand for this industry's IPOs. Issuers take the advantage of a favourable IPO climate in the industry to float their shares. Hence, Allen and Faulhaber (1989) argue that the new prospect of a highly profitable natural resource industry in the early 1980s may have been the impetus of the 1980 hot issue market, characterised by both large underpricing and large numbers of natural resource IPOs.[26]

3.3 Explanations for the Existence of Cycles in IPO Activity

The above explanations for the existence of cycles in the IPO activity are limited and are not fully satisfactory. As IPO activity and underpricing are likely to arise from the interaction of investor demand and firm supply, we now review explanations classified into two categories - supply and demand.

3.3.1 Supply of IPOs

3.3.1.1 Changes in Firm Risk

An initial explanation of hot issue markets is developed by Ritter (1984b). His argument is based on the empirical finding that high-risk IPOs are relatively more underpriced than low-risk IPOs[27] (see also Davis and Yeomans 1976; Beatty

[26] This effect may also have occurred in the late 1990s in relation to internet firms.
[27] In Ritter (1984b), the risk of an IPO is measured in terms of an information proxy, such as annual sales of the company.

and Ritter 1986; Miller and Reilly 1987) and an adverse selection model developed by Rock (1986).

Rock (1986) argues that IPO underpricing is merely compensation to investors for the costs of becoming informed.[28] The greater the fundamental uncertainty about an issue, the greater the IPO underpricing to compensate investors. To avoid the possible failure of IPOs, issuers have to underprice their issues. Koh and Walter (1989), using Singaporean IPO data, provide support for Rock's theory.

Of note, the uncertainty mentioned in Rock (1986) is not systematic beta-type risk but the uncertainty uninformed investors have regarding the aftermarket price of an issue (Ritter 1984b). Rock's model thus implies that riskier issuers must underprice more than firms that have lower risks.

Based on the above arguments, Ritter (1984b) suggests that if high-risk IPOs represent an unusually large proportion of offerings in specific periods, high average IPO underpricing should be observed in these periods leading to hot issue markets. However, this explanation is subject to criticism. First, as mentioned by Ritter (1984b), most high risk IPOs have small market capitalisations. The amplitude of the hot issue cycle will be reduced if we use a value-weighted average IPO underpricing index rather than an equally weighted index.

Second, the changing risk composition hypothesis cannot explain industry effects. Based on the findings of Ritter (1984b), the US hot issue IPO market of 1980 is due to a specific industry - natural resources. Since high-risk IPOs were also issued in other industries during the period, the explanation of changing risk

[28] Details refer to Sub-section 2.3.1.2 of the thesis.

composition is not the only explanation for the observed 1980 hot issue cycle in the USA.

Third, the calculation of the risk of an IPO is difficult. Since the share trading history of IPOs is not available by definition, proxies for risk have to be used. In Ritter (1984b), accounting information is used to measure ex-ante risk, such as annual sales of companies. However, the measure of annual sales is not generally viewed as an accurate measure of risk in terms of business and financial risk.

3.3.1.2 Windows of Opportunity

An explanation for cycles in IPO volume is based upon the finding of long run underperformance of IPOs. Ritter (1991) finds a negative relation between annual IPO volume and the aftermarket performance of IPOs. He argues that issuers have some success in timing new issues to take advantage of windows of opportunity. Since there are periods when investors place high valuations on the future growth opportunities of companies,[29] companies may be more likely to go public in these periods. This induces cycles in the volume of new issues.

The studies of Loughran and Ritter (1995) on the long run performance of IPOs, and Bayless and Chaplinsky (1996) on long run performance of seasoned equity issues, support the argument for windows of opportunity. Moreover, Rajan and Servaes (1997) argue that windows of opportunity are at least partially related to analyst over-optimism about recent IPOs.

[29] Growth opportunities of a company can be reflected by some ratio indicators relative to other measures of value (e.g., price-earnings or market to book ratios).

Since the literature indicates that some hot issue markets are related to specific industries, or caused by specific industry shocks in specific periods, optimistic valuation of the growth potential of companies by investors may be possibly concentrated in specific industries in specific periods due to the influence of business conditions (Ritter 1984b; Allen and Faulhaber 1989). For instance, the 1980 hot issue market in the USA is believed to be due to 1979 OPEC oil shock.

3.3.1.3 The Impact of Mutual Fund flows

Based on the reports of financial analysts, Ritter (1998) argues that there might be a relationship between IPO volume and mutual fund flows. Mutual fund managers are more willing to invest in IPOs in periods when they have a net inflow of cash. If enough mutual fund managers are in this position, the inflow of mutual funds into the IPO market might lead to a rise in demand for IPOs inducing over-valuation. Issuers take advantage of high valuations by timing their issues for these periods. Conversely, net cash outflow might lead to a fall in demand for IPOs inducing under-valuation. Hence a lower IPO volume is expected for these periods. To date, there is no empirical test of this hypothesis.

However, the idea of concentrating on the 'net inflow of cash' is problematic. If investing in IPOs is perceived to be a better investment option than other current investments, mutual funds can simply liquidate their current positions, incur transaction costs and buy into the IPO market without relying on the cash inflow of their mutual funds. But this might be explained by the limit on the quantity of shares a mutual fund can purchase in an IPO. Further, redemption requests by investors impose restrictions on the mutual funds since they have to maintain a certain level of cash reserves to meet redemption requests. Hence, their assets might not be fully invested (Chordia 1996; Chay 1996).

3.3.2 Demand for IPOs

3.3.2.1 Positive Feedback Strategy

This hypothesis relies on the assumption that some investors follow positive feedback strategies, in which they expect a positive autocorrelation in the initial returns on IPOs (see Rajan and Servaes 1995). The hypothesis is quite similar to the cascade effect hypothesis developed by Welch (1992), who argues that later investors rely at least partly on the purchasing decisions of earlier investors.

The investment decision in relation to a specific IPO is based on the success of other recent (or earlier) issues. With the assumption of some degree of homogeneity among IPOs, investors interpret successes of recent issues as an indication of the success of future issues. The implication is that once an issue goes public, these investors are willing to bid up the price if other recent issues have realised an increase in prices. As Ibbotson et al. (1994, p. 72) suggest

> *"If enough investors follow such a strategy, they may end up causing the expected positive autocorrelation of initial returns in a kind of self-fulfilling prophecy."*

The study of Ibbotson et al. (1994) in the US market provides supportive evidence for this argument. They find that current month average IPO underpricing is a good predictor of next month's average initial return with a first-order autocorrelation of 0.66 and the persistence of IPO volume from month to month is even stronger with a first-order autocorrelation of 0.89. Ibbotson and Jaffe (1975) also find that the first-order autocorrelation of market adjusted IPO underpricing is quite large at 0.74 and argue that hot issue markets are somewhat predictable.

3.3.2.2 The Impact of Mutual Funds

Researchers have also begun to pay attention to the recent tendency of fund managers to employ a passive investment strategy (e.g. Grinblatt and Titman 1989, 1992; Goetzmann and Ibbotson 1994; Brown and Goetzmann 1995; Malkiel 1995). Mutual fund managers have the option to take either an active or passive investment strategy. The passive approach is relatively easy and simple to implement (Boustridge and Young 1996). Since the performance of mutual fund managers is often judged by comparing their portfolio performance relative to the performance of a predetermined stock market index (Roll 1992),[30] one popular passive strategy employed by fund managers is to replicate the benchmark index. This indexing strategy can avoid potential cash withdrawals. Some mutual funds have employed this approach in recent years (e.g. Powell, Premechandra and Shi 1998).

IPO listings typically change the composition of the share market index.[31] On average, IPOs experience positive initial returns on the first day of trading. This implies that all else being equal, the stock market index would tend to rise on the date of an IPO listing if the stock is to be included in the market index. Since the performance of mutual fund managers is often judged in comparison to a

[30] This predetermined index is generally a broadly based stock market index.

[31] For instance, Telecom NZ listed on the New Zealand Stock Exchange on 22 August 1991 and it represents more than 60% of the weight in the NZSE40 index.

predetermined stock market index, they are likely to underperform the market if they do not invest in IPOs.

With the information advantage mutual funds have (Edwards and Zhang 1998), they are more likely to invest in IPOs with an offer price less than the fundamental value, as suggested by Rock (1986). Economic upturns are generally associated with over-optimistic valuation by investors which results in a relative higher fundamental value for IPOs. Therefore, in periods of over-optimism, mutual funds may be heavily involved in the IPO market, inducing a rise in demand for IPOs that leads to a hot period of underpricing.

3.3.2.3 Interest Rates

Another explanation for the relationship between interest rate and equity offerings is related to investors' demand for equity. A decrease in interest rates is generally associated with a fall in bond yields (Harvey 1991). Subsequently, a lower return on bond investments is expected. Investors who want protection against this possibility may transfer their funds into other higher yield investments, such as the stock market. In turn, this induces a rise in demand for IPOs. If enough investors follow this strategy, a hot issue market (in terms of IPO underpricing) might occur.

In addition, the negative relation between interest rates and stock prices has been the subject of extensive research (e.g. Fama and Schwert 1977; Titman and Warga 1989). In theory, the value of a share is the sum of discounted future cash flows. One important component in this model is the discount rate (which is positively related to the interest rate). In general, a decrease in interest rates increases the value of shares. This in turn increases expectations about the future performance of a new issue inducing higher investor demand and thereby leading to higher IPO underpricing.

3.4 Summary

A number of explanations have been advanced to explain the phenomenon of hot and cold new issue markets. These explanations include changing risk composition of IPOs, positive feedback strategy of investors, windows of opportunity and the impact of mutual fund flows. However, none of these appear to provide a full explanation. Moreover, the scant empirical evidence is sometimes mixed and not always supportive. Of note, previous studies have concentrated on supply-side explanations (or issuers). The importance of investor demand for IPOs is often overlooked.

CHAPTER FOUR

DESCRIPTION AND SOURCES OF IPO DATA

4.1 Introduction

This chapter describes the data collection procedures and sources of the various IPO data sets used in this thesis. The summary statistics for each data set are also briefly presented.

4.2 US IPO Data[32]

4.2.1 Data Sources and Collection Method

The data were initially collected from the Securities Data Corporation (SDC). SDC maintains files on all registered security issues. These files are based primarily on information filed with the Securities and Exchange Commission (SEC) in public registration statements.

The following selection criteria were employed:[33]

a) The IPO must be a common stock IPO. The issues under Rule 144A, Private Placements and Shelf Registrations are excluded.

[32] I would like to thank Jay Ritter, John Powell, Peter Grundy and Gurmeet Bhabra for providing some US IPO and share price data.

[33] Research has often concluded that Closed-end Mutual Fund and REITs are different from corporate assets (e.g. Peavy 1990; Wang et al. 1992; Nelling et al. 1995; Sirmans et al. 1987). Generally, these studies show that the Closed-end Mutual Funds and REIT stocks are overpriced relative to the traditional underpricing observed in common stocks. Following Ibbotson et al. (1994), it was decided to exclude Closed-end Mutual Funds and REITs from the sample.

b) Closed-end Mutual Funds and Real Estate Investment Trusts (REITs) are excluded

c) The IPO must be issued by a US based company

From the SDC files, a list of all USA domestic firm-commitment IPOs of common stock is obtained for the period of January 1970 to June 1998. The initial sample consists of 8,879 IPOs.

To calculate initial returns for each IPO, the stock price at the end of the first day of trading for each IPO is required. The SDC files only provide the relevant price information for stocks over the period 1986–1998. Thus, the price information for the remainder of the sample is obtained from other sources.

For those IPOs listed between 1975-1984, the price information for 1,646 companies is first obtained from Ritter's 1975-1984 IPO database.[34]

Second, the price information for 2,189 companies listed between 1975–1996 is obtained from the Center for Research in Security Prices (CRSP) database. Among them, 1,556 stocks were found to have a negative closing price on the first day of trading, even though the trading volume was positive. The price information for these stocks in the subsequent two trading weeks was checked. In all cases when the first-day trading price for the company was negative, prices for the subsequent two weeks were also negative. The trading price for a few companies in the subsequent three years was then examined. The results showed that these companies had negative prices for the first two or three years before becoming positive. However, the stocks had positive volumes throughout.

[34] There were a total number of 1,782 IPOs in the period 1975–1984 (see Ritter 1997). It should be noted that there were some best efforts contracts included in Ritter's data whereas this thesis concentrates on firm commitment contracts.

The CRSP Stock File Guide explains this as follows:

"PRC(I) is the closing price or the negative bid/ask average on the date CALDT(I). If the closing price is not available on any given trading day, the number in the price field has a negative sign to indicate that it is a bid/ask average and not an actual closing price on trading date CALDT(I). Please note that in this field the negative sign is a symbol and that the value of the bid/ask average is not negative. If neither closing price nor bid/ask average is available on day I, PRC(I) is set to zero." [35]

(*CRSPAccess97 Stock File Users Guide*, page 44, 1997, University of Chicago.)

The procedures followed indicated that there were still 2,164[36] stocks requiring the price information for the first day of trading with 1,556 having negative price information from CRSP thereby indicating no last sale price available. For these stocks, an *implied closing price* was calculated by averaging the bid and ask quotes.

Third, price data were collected for all the stocks requiring price information (including the 1,556 stocks with implied closing prices flagged by CRSP) from Datastream International (DS) and Prophet Stock Price CD-ROM (PSPC).

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[35] Note: PRC (1) means the price of first day of trading with PRC (.) denotes the closing price or bid/ask average. CALDT (1) means the first trading date with CALDT (.) denotes the calendar date.

[36] This number (2,164) is equal to total number of the stocks in the initial sample (8,879) minus 4,436 stocks that had relevant price information from SDC and then less 633 stocks for which the price information was obtained from CRSP.

After the third step, there were 1,715 companies that had either missing price information or implied closing prices at the first day of trading.[37]

The procedures above revealed that it is unlikely that any price information could be obtained for the companies listed prior to 1974 as neither DS or PSPC provide any information on these companies.[38] Therefore, 1,062 IPOs issued prior to 1974 were eliminated which left 7,817 IPOs in the final sample for the period of 1974 to June 1998.[39]

The above procedures also revealed the existence of unit IPOs in the sample. A unit IPO represents a combination of securities such as common stock, debt preferred stock and warrants rather than common stock alone. Unit offerings are complex instruments that consist of a bundle of common stock offerings and other securities sold together as a package, typically with warrants. Unit IPOs have become increasingly popular in recent years. Unit IPOs are relatively smaller in terms of offer sizes and firm sizes. They are typically riskier and are underwritten by less prestigious underwriters in comparison to non-unit offerings. Moreover, they are likely to disappear more quickly (Schultz 1993; Jain 1994).

While there exists literature on stock IPOs and their underpricing behaviour, research in unit IPOs remains a largely unexplored area. Schultz (1993) documents an empirical result of 8% higher underpricing in unit IPOs. In contrast, Jain (1994) shows that unit IPOs exhibit significantly less underpricing than stock IPOs. This

[37] The data set was also checked for the IPOs that had 'doubtful' price information. For instance, the stock is referred as having doubtful price information if the initial return of stock is greater (less) than 20% (-20%) could not be confirmed. As a result, companies with doubtful price information are identified within the group of companies that had missing price information.

[38] Although CRSP provides price information for a proportion of IPOs listed prior to 1974, the first-day trading prices obtained for these companies were negative (or implied closing price).

[39] These procedures revealed that there were still 653 stocks in the sample requiring price information after this step. Within this group, 300 IPOs are unit offerings (see discussion of unit offerings in this section).

evidence suggests that there may be a significant difference in underpricing (or the initial return) between unit and stock IPOs. Consequently, unit IPOs were eliminated from the sample due to the complexity and problems of valuation and the possible difference in the underpricing between unit and stock IPOs.

It is also recognised that over the period 1974-1975, almost half of IPOs (6 out of 13) have either implied closing prices or missing price information in addition to the existing problem of a relatively small number of offerings during the period. This increases the difficulty in constructing monthly hot issue market indices since many months over this period would have no IPOs. One way to deal with this problem is to measure the hot issue market indices, such as average initial return, number of offerings and value of offerings, as zero for the specific months.[40] To reduce the potential bias in the empirical tests, IPOs for the period 1974-1975 are excluded altogether.

After eliminating unit IPOs and the IPOs between 1974 and 1975, the final sample consists of 6,632 IPOs with 250 of them having implied closing prices and 97 possessing no price information.

4.2.2 Descriptive Statistics of US Sample

4.2.2.1 Full Sample

Table 4.1 presents summary statistics for the full sample of US IPOs.[41] Of note from Table 4.1, the number of offerings has increased sharply since 1980 and

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[40] It is shown in later chapters that the hot issue periods in the IPO activity are empirically examined using a regime switching technique and this technique can be quite sensitive to zeroes.

[41] Table 4.1 includes all the IPOs with and without implied closing prices.

peaked in the 1990s with the average offer size increasing from US$9.8 million in 1980 to US$69.1 million in 1998. The overall average offer size is US$29.6 million, which is much higher than US$5.9 million average, in unit offerings (see Table 4.3). The average initial return per year ranges from 4.26% in 1984 to 32.81% in 1978.[42] This issue is further explored in sub-sections 4.2.2.4 and 4.2.2.5.

The average initial return for the overall sample is 13.18% including companies with implied closing prices and 10.19% excluding companies with implied closing prices. These results are quite similar to the results of Ibbotson et al. (1988)[43] and Ibbotson et al. (1994).[44]

Table 4.2 summarises the results for all the IPOs by industry classification. The industry of Personal, Business and Repair Services shows the highest initial return of 18.24% with the Sanitation industry the least with an average initial return of 1.47%. Two industries, Personal, Business and Repair Services and Manufacturing, capture a relatively large proportion of total IPO issuance in the sample period (54.2% of total number of offerings).

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[42] The initial returns for the companies that had implied closing prices are calculated using the average values of the bid and ask quotes. Excluding the IPOs that had implied closing prices, there were some different results in average initial returns in three of the years (1976, 1978 and 1985). Moreover, the difference is statistically significant at 5% level with a t-statistic of 2.17.

[43] Ibbotson et al. (1988) report that for the 8,668 firms that went public during 1960-1987 in the USA, the average initial return is 16.37%.

[44] Using US data for the period 1960 to 1992, Ibbotson et al. (1994) report an average initial return of 15.3% for a sample of 10,626 IPOs.

Table 4.1: Summarised Results for US IPOs (excluding Unit Offerings) Classified by Year

	No. of Offerings	Average Initial Return per Year		Gross Proceeds per Year (US$ mil.)	Average Proceeds per Year (US$ mil.)
		Including IPOs with implied closing prices	Excluding IPOs with implied closing prices		
1976	37	0.15230	0.00767	260.0	7.0
1977	24	0.07770	0.07988	137.7	5.7
1978	34	0.32811	0.12095	209.8	6.2
1979	58	0.12601	0.08137	377.0	6.5
1980	120	0.26116	0.28509	1,172.7	9.8
1981	291	0.15693	0.13473	2,765.1	9.5
1982	97	0.10601	0.10457	1,152.3	11.9
1983	574	0.10375	0.10187	11,662.0	20.3
1984	251	0.04260	0.04236	2,770.0	11.0
1985	270	0.10332	0.04661	5,996.4	22.2
1986	561	0.06479	0.06133	16,658.0	29.7
1987	400	0.07721	0.06003	12,399.0	31.0
1988	158	0.06599	0.06846	4,663.9	29.5
1989	135	0.09622	0.09205	4,806.9	35.6
1990	131	0.13538	0.10785	4,122.4	31.5
1991	302	0.12294	0.12294	14,203.0	47.0
1992	415	0.10739	0.10739	19,747.0	47.6
1993	525	0.12748	0.12748	26,550.0	50.6
1994	414	0.09215	0.09215	15,180.0	36.7
1995	462	0.21576	0.21576	23,947.0	51.8
1996	695	0.17302	0.17302	37,600.0	54.1
1997	471	0.14815	0.14815	26,900.0	57.1
1998	207	0.14646	0.14646	14,303.0	69.1
Overall	**6,632**	**0.13178**	**0.10192**	**247,583.2**	**29.6**

Note: The data period is from 1974 to June 1998. The figures for 1998 are only for the first half of the year.

Table 4.2: Summarised Results for US IPOs (excluding Unit Offerings) Classified by Industry

	No. of Offerings	% of Total IPOs	Average Initial Return per Industry		Gross Proceeds per Industry (US$ mil.)	Average Proceeds per Industry (US$ mil.)
			Including IPOs with implied closing prices	Excluding IPOs with implied closing prices		
Agriculture	33	0.50%	0.05436	0.05436	1,204.2	36.5
Commercial Banks	113	1.70%	0.06698	0.05194	2,002.9	17.7
Construction	73	1.10%	0.09003	0.08994	2,081.4	28.5
Credit Institutions	57	0.86%	0.16067	0.16280	5,820.1	102.1
Healthcare	257	3.88%	0.09000	0.09059	7,616.4	29.6
Insurance	172	2.59%	0.06690	0.06902	17,183.4	99.9
Investment Banks	61	0.92%	0.08219	0.07613	4,418.0	72.4
Leisure	116	1.75%	0.14616	0.13765	3,436.8	29.6
Manufacturing	2,422	36.52%	0.12519	0.11782	84,007.5	34.7
Natural Resources	181	2.73%	0.16562	0.11032	9,806.3	54.2
Other Financial Institutions and Banks	165	2.49%	0.08695	0.08367	8,117.3	49.5
Other Services	85	1.28%	0.06454	0.06440	4,693.9	55.2
Personal, Business and Repair Services	1,174	17.70%	0.18240	0.18282	34,432.2	29.3
Restaurants and Hotels	212	3.20%	0.14915	0.15131	6,388.6	30.1
Retails	406	6.12%	0.09263	0.09593	17,267.2	42.5
Savings and Loans, Mutual Savings Banks	356	5.37%	0.06509	0.04825	8,206.9	23.1
Sanitation	58	0.87%	0.01469	0.12303	2,260.1	39.0
Telecommunication	215	3.24%	0.11661	0.11745	13,227.3	61.5
Transportation	157	2.37%	0.07772	0.07156	7,067.1	45.0
Wholesales	314	4.73%	0.11690	0.11439	8,341.2	26.6
Unknown Industry	6	0.09%	-0.10000	-0.10000	4.7	0.8
Overall	**6,632**	**100%**	**0.13178**	**0.10192**	**247,583.2**	**29.6**

1. Other Financial Institutions and Banks include mortgage bankers, mortgage securities and real estate, etc.
2. Other Services include electric, oil and gas, education and social services.
3. Telecommunication includes telephone communications, television broadcasting, radio broadcasting and communication services.
4. Unknown Industry means the industry classification is not defined by SDC.

4.2.2.2 *Unit IPOs*

Summarised results for US unit IPOs classified by both year and industry are reported in Tables 4.3 and 4.4, respectively. Table 4.3 shows that the average proceeds for unit IPOs were only US$5.9 million per offering which is small relative to the overall sample as reported in Table 4.1 (US$29.6 million per offering). The number of unit offerings peaked in the mid-1980s with high initial returns. Although unit offerings were still quite popular in the 1990s, the average initial return was much lower compared to the 1980s. Table 4.4 shows that two industries, Personal, Business and Repair Services and Manufacturing, dominate the issuing of unit IPOs (58.07%) with 229 and 451 offerings, respectively. The Sanitation industry experienced the highest average initial returns (93.54%) with the Credit Institutions industry the least with an average initial returns of -9.34% (see Table 4.4).[45]

While it does not initially seem that there is a difference in the average initial returns between unit and stock IPOs, tests for differences in the initial returns are presented in the next sub-section.

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[45] The high average initial returns in the Sanitation industry appear to be dominated by a single company, the shares of Envirosure Management issued on 16 July 1985 with an initial return of 650%. When this outlier is excluded, the initial return for the industry falls to 7.95%.

Table 4.3: Summarised Results for US Unit Offerings Classified by Year

	No. of Offerings	Average Initial Return per Year	Gross Proceeds per Year (US$ mil.)	Average Proceeds per Year (US$ mil.)
1976	1	-0.02778	2.8	2.8
1977	4	0.08398	8.8	2.2
1978	3	0.35833	5.4	1.8
1979	3	-0.02639	11.5	3.8
1980	23	0.28926	97.1	4.2
1981	48	0.29346	225.4	4.7
1982	22	0.22509	71.8	3.3
1983	97	0.18950	386.8	4.0
1984	90	0.13010	298.1	3.3
1985	54	0.29872	241.6	4.5
1986	122	0.12708	406.0	3.3
1987	99	0.03941	452.4	4.6
1988	51	0.14291	154.3	3.0
1989	60	0.12207	253.3	4.2
1990	35	0.07520	183.1	5.2
1991	50	0.04649	343.2	6.9
1992	61	0.03275	589.6	9.7
1993	79	0.05435	742.5	9.4
1994	93	0.03947	690.3	7.4
1995	63	0.10444	453.8	7.2
1996	71	0.10262	717.7	10.1
1997	39	0.03686	483.7	12.4
1998	3	0.09075	36.1	12.0
Overall	**1,171**	**0.12299**	**6,855.3**	**5.9**

The data period is from 1974 to June 1998. The figures for 1998 are only for the first half of the year.

Table 4.4: Summarised Results for US Unit Offerings Classified by Industry

	No of Offerings	Average Initial Return per Industry	Gross Proceeds per Industry (US$ mil.)	Average Proceeds per Industry (US$ mil.)
Agriculture	8	-0.04410	41.8	5.2
Construction	9	-0.02811	55.3	6.1
Credit Institutions	3	-0.09343	24.0	8.0
Healthcare	49	0.12614	205.3	4.2
Insurance	9	0.04046	30.7	3.4
Investment Banks	5	0.08125	20.5	4.1
Leisure	57	0.07900	377.3	6.6
Manufacturing	451	0.10487	2,670.6	5.9
Natural Resources	22	0.27259	89.0	4.0
Other Financial Institutions and Banks	91	-0.04995	671.3	7.4
Other Services	14	0.19454	41.8	3.0
Personal, Business and Repair Services	229	0.15614	1,325.7	5.8
Restaurants and Hotels	31	0.10015	174.9	5.6
Retails	51	0.10337	305.0	6.0
Savings and Loans, Mutual Savings Banks	6	-0.08757	49.4	8.2
Sanitation	7	0.93539	53.7	7.7
Telecommunication	37	-0.01347	187.0	5.1
Transportation	20	0.04626	147.3	7.4
Wholesales	72	0.19849	384.7	5.3
Overall	**1,171**	**0.12299**	**6,855.3**	**5.9**

1. Other Financial Institutions and Banks include mortgage bankers, mortgage securities and real estate.
2. Other Services include electric, oil and gas, education and social services.
3. Telecommunication includes telephone communications, television broadcasting, radio broadcasting and communication services.

4.2.2.3 *Unit IPO vs. Common Stock IPOs*

It has been reported that there is significant difference in the initial returns between unit and stock IPOs (Schultz 1993; Jain 1994). Tables 4.5 and 4.6 report the statistical analysis of the difference in initial returns between unit and common stock IPOs with Table 4.5 classified by year and Table 4.6 classified by industry.

Table 4.5: Test of Differences in the Initial Returns between Unit and Stock IPOs in the USA by Year

	F-Statistic	t-statistic/ Adjusted t-statistic	Wilcoxon Score
1976	N.A.	N.A.	-0.56
1977	7.69	-0.08	0.92
1978	3.70	-0.04	0.39
1979	316.38*	2.69*	-1.69
1980	1.63	-0.23	1.21
1981	2.25*	-0.91	-0.37
1982	13.15*	-0.87	-1.17
1983	2.39*	-2.22*	1.00
1984	8.72*	-2.04*	0.67
1985	14.46*	-1.23	-1.06
1986	4.62*	-1.52	-0.72
1987	3.15*	1.05	-2.68*
1988	6.13*	-1.43	-0.02
1989	6.18*	-0.55	-1.10
1990	1.03	1.03	-2.02*
1991	2.69*	1.99	-3.76*
1992	2.20*	2.06*	-4.32*
1993	3.68*	1.65	-5.58*
1994	6.04*	1.30	-4.81*
1995	1.05	2.98*	-4.10*
1996	1.58*	1.77	-2.81*
1997	1.81*	2.40*	-2.24*
1998	3.78	0.46	-0.34
Total	**2.72***	**0.43**	**-9.72***

1. * Significant at 5% level.
2. The tests were conducted including those companies with implied closing prices when calculating the initial returns.
3. N.A. denotes Not Available.

F-statistics test the hypothesis that the variances are equal across unit and stock IPOs. If unequal variances are observed, the adjusted t-statistic is used rather than a standard t-statistic in analysing the difference in underpricing. As the normal distribution assumption is likely to be violated in the data, the non-parametric Wilcoxon rank-sum test is also used.

Table 4.5 compares the initial returns between unit and stock offerings by year. The results obtained from the parametric and non-parametric tests are generally similar, except for nine of the years, 1979, 1983, 1984, 1987, 1990, 1991, 1993, 1994 and 1996.

The results are more mixed for the difference in initial returns between unit and stock IPOs by industry. While the non-parametric test shows a significant difference in initial returns between unit and stock IPOs for most industries, the parametric test shows only three industries wherein significant differences in the initial returns between unit and stock IPOs are found (see Table 4.6). Assuming possible violation of the assumption of normality, the statistical results obtained from the non-parametric tests are more reliable.

Both non-parametric and parametric tests are also conducted for the overall sample. The result obtained for the non-parametric test indicates a significant difference in the initial returns between unit and stock IPOs (Wilcoxon score of –9.72) though the result obtained for the parametric test indicates no significant difference (adjusted t-statistic of 0.43).

Table 4.6: Test of Differences in the Initial Returns between Unit and Stock IPOs in the USA by Industry

	F-Statistic	t-statistic/ Adjusted t-statistic	Wilcoxon Score
Agriculture	1.18	2.27*	-2.33*
Commercial Banks	N.A.	N.A.	N.A.
Construction	3.78*	1.12	-1.98*
Credit Institutions	3.00	1.94	-2.28*
Healthcare	6.00*	-0.50	-2.35*
Insurance	N.A.	N.A.	N.A.
Investment Banks	2.08	0.01	-1.23
Leisure	1.32	1.49	-2.81*
Manufacturing	1.73*	1.16	-6.06*
Natural Resources	1.99	-0.70	0.91
Other Financial Institutions and Banks	1.74	3.09*	-3.60*
Other Services	6.77*	-1.11	0.42
Personal, Business and Repair Services	2.74*	0.64	-5.20*
Restaurants and Hotels	1.43	1.03	-2.11*
Retails	5.18*	-0.17	-2.64*
Savings and Loans, Mutual Savings Banks	1.54	1.84	-2.40*
Sanitation	100.53*	-0.85	-1.05
Telecommunication	1.52	3.03*	-3.71*
Transportation	3.59*	0.49	-2.06*
Wholesales	3.33*	-1.79	0.45
Unknown Industry	N.A.	N.A.	N.A.
Total	**2.72***	**0.43**	**-9.72***

1. * Significant at 5% level.
2. The tests were conducted including those companies with implied closing prices when calculating the initial returns.
3. N.A. denotes Not Available.

Of note, the unit IPOs tend to outperform (underperform) stock IPOs prior to 1990 (after 1990). While the finding of superior performance of unit offerings relative to stock offerings prior to 1990 is consistent with the US evidence of Schultz (1993),[46] the superior performance of stock offerings after 1990 is more in line with the findings of Jain (1994).[47] The differences highlighted here between unit and stock IPOs support the decision to exclude unit IPOs. Research into the difference between unit and common stock IPOs is considered beyond the scope of the thesis and is left for future work.

4.2.2.4 IPOs with Implied Closing Prices

As discussed in Sub-section 4.2.1, there are a number of companies that had no available closing price at the first day of trading. The price used in calculating the initial return for these IPOs in the sample is set as the average value of bid and ask quotes at the first day of trading (termed 'implied closing price'). Although the proportion of these companies is relatively small in the sample, the initial returns calculated for these companies might impact on the construction of the hot issue market indices. Therefore, it is necessary to examine descriptive statistics of these observations.

The summarised results for IPOs with implied closing prices are reported in Tables 4.7 and 4.8. It appears that these IPOs have much higher initial returns and relatively small offer sizes when compared to the results in Tables 4.1 and 4.2 (see Tables 4.7 and 4.8). Extremely high initial returns are experienced in 1976, 1978

[46] The sample period used in Schultz (1993) is from 1986-1988.

[47] The sample period used in Jain (1994) is from 1980-1988.

and 1990 with average initial returns of 159.88%, 291.76% and 129.17%, respectively. For IPOs listed after 1990, there are none with an implied closing price.

Table 4.7: Summarised Results for US IPOs with Implied Closing Prices Classified by Year

	No. of Offerings	Average Initial Return per Year	Gross Proceeds per Year (US$ mil.)	Average Proceeds per Year (US$ mil.)
1976	3	1.59880	19.4	6.5
1977	4	0.06397	7.2	1.8
1978	4	2.91761	2.6	0.7
1979	12	0.20264	67.6	5.6
1980	12	0.05176	95.0	7.9
1981	15	0.55507	192.8	12.9
1982	3	0.15120	41.4	13.8
1983	6	0.13047	294.6	49.1
1984	3	0.06279	19.6	6.5
1985	121	0.16941	1,354.9	11.2
1986	34	0.11652	262.1	7.7
1987	22	0.36921	133.8	6.1
1988	5	-0.00738	32.5	6.5
1989	3	0.27326	9.2	3.1
1990	3	1.29167	12.8	4.3
Total	**250**	**0.24690**	**2,745.5**	**10.2**

Note: The data period is from 1974 to June 1998.

Table 4.8: Summarised Results for US IPOs with Implied Closing Prices Classified by Industry

	No. of Offerings	Average Initial Return per Industry	Gross Proceeds per Industry (US$ mil.)	Average Proceeds per Industry (US$ mil.)
Commercial Banks	9	0.23239	52.7	5.9
Construction	3	0.09201	19.2	6.4
Credit Institutions	2	0.10324	13.4	6.7
Healthcare	8	0.07221	131.5	16.4
Insurance	5	-0.00240	65.5	13.1
Investment Banks	2	0.25083	8.3	4.2
Leisure	6	0.29640	17.0	2.8
Manufacturing	76	0.33767	720.4	9.5
Natural Resources	4	3.46528	3.6	0.9
Other Financial Institutions and Banks	4	0.23250	75.6	18.9
Other Services	2	0.07014	13.7	6.9
Personal, Business and Repair Services	22	0.17491	170.1	7.7
Restaurants and Hotels	4	0.03905	11.6	2.9
Retails	17	0.04719	305.1	17.9
Savings and Loans, Mutual Savings Banks	59	0.14818	728.9	12.4
Sanitation	4	0.47036	30.2	7.6
Telecommunication	3	0.02912	45.0	15.0
Transportation	6	0.23171	44.9	7.5
Wholesales	14	0.17348	84.8	6.1
Total	**250**	**0.246890**	**2,545.5**	**10.2**

1. Other Financial Institutions and Banks include mortgage bankers, mortgage securities, and real estate.
2. Other Services include electric, oil and gas, education and social services.
3. Telecommunication includes telephone communications, television broadcasting, radio broadcasting and communication services.

In Table 4.8, an extremely high return of 346.53% is observed in the Natural Resources industry with an average offering size of only US$0.9 million. The Insurance industry is the only industry with a negative initial return.

As relatively high initial returns for companies that had implied closing prices are observed in Tables 4.7 and 4.8, it implies that there might be a possible impact of these companies when constructing the monthly hot issue market indices. Therefore, some further analysis is conducted in the next sub-section to explore if this impact is likely to be significant.

4.2.2.5 IPOs with Closing Prices vs. IPOs with Implied Closing Prices

The above evidence hints that there might be a potential bias in the initial returns for these companies if the implied closing price (which is set as the average value of bid and ask quotes) is used to calculate the initial return. Therefore, a comparison analysis for companies with actual closing prices and companies with implied closing prices is performed and the results are reported in Table 4.9 by year and in Table 4.10 by industry classification.

The overall results indicate that there is a significant difference in the initial returns between the companies with actual closing prices and companies with implied closing prices, although the difference is apparent mainly between 1985-1989 (see Table 4.9).

Based on the results observed in Tables 4.9 and 4.10, there is a potential bias in initial returns for companies with implied closing prices and such a bias may have an impact when constructing monthly hot issue market indices.

Therefore, these companies are excluded from the construction of the monthly underpricing index.[48]

Table 4.9: Test of Differences in Initial Returns between IPOs with Price Information and IPOs with Implied Closing Prices in the USA by Year

	F-statistic	t-statistic/ Adjusted t- statistic	Wilcoxon Score
1976	916.22*	-1.05	2.16*
1977	2.01	0.16	0.10
1978	329.6*	-1.06	1.62
1979	37.25*	-0.84	-0.21
1980	3.10*	2.18*	-1.87
1981	5.00*	-1.22	1.29
1982	1.54	-0.45	0.32
1983	2.82*	-1.13	1.75
1984	5.70	-0.27	1.59
1985	11.41*	-3.51*	3.83*
1986	3.52*	-1.05	1.38
1987	12.24*	-3.31*	4.67*
1988	1.14	1.26	-1.08
1989	1.59	-2.50*	2.07*
1990	62.56*	-1.73	1.41
1991	NA	N.A.	N.A.
1992	N.A.	N.A.	N.A.
1993	N.A.	N.A.	N.A.
1994	N.A.	N.A.	N.A.
1995	N.A.	N.A.	N.A.
1996	N.A.	N.A.	N.A.
1997	N.A.	N.A.	N.A.
1998	N.A.	N.A.	N.A.
Total	**8.14***	**-3.05***	**2.25***

1. * Significant at 5% level.
2. N.A. denotes Not Available.

[48] However, the number of offerings and offer sizes of these companies are still retained in the construction of monthly indices of issue volume and value.

Table 4.10: Test of Differences in Initial Returns between IPOs with Price Information and IPOs with Implied Closing Prices in the USA by Industry

	F-statistic	t-statistic/ Adjusted t-statistic	Wilcoxon Score
Agriculture	N.A.	N.A.	N.A.
Commercial Banks	21.93*	-1.06	0.29
Construction	154.57*	-0.10	1.22
Credit Institutions	5.43	0.37	0.00
Healthcare	3.81	0.36	0.23
Insurance	23.23*	5.82*	-2.14*
Investment Banks	10.69*	-0.61	0.02
Leisure	6.19*	-0.67	1.00
Manufacturing	11.32*	-2.76*	2.70*
Natural Resources	58.16*	-2.03	2.74*
Other Financial Institutions and Banks	4.39*	-0.74	0.51
Other Services	1.48	-0.06	-0.03
Personal, Business and Repair Services	2.08*	0.14	0.07
Restaurants and Hotels	33.44*	4.28*	-0.33
Retails	2.91*	1.08	-0.24
Savings and Loans, Mutual Savings Banks	28.88*	-1.70	2.88*
Sanitation	16.78*	-1.00	0.88
Telecommunication	10.78	0.60	-0.66
Transportation	9.81*	-1.05	1.09
Wholesales	2.80*	-0.68	-0.30
Unknown Industry	N.A.	N.A.	N.A.
Total	**8.14***	**-3.05***	**2.25***

1. * Significant at 5% level.
2. N.A. denotes Not Available.

4.2.2.6 IPOs with Missing Price Information

Although a great proportion of companies in the sample have available price information on the first day of trading, there are still 97 companies possessing no price information with 20 of them (20.6% of the companies) in 1986 (see Table 4.11). Further, 28 of them (28.86% of the companies) are observed in the industry of Financial Institutions and Banks (see Table 4.12). These companies show a relatively small offer size.

Although these companies are excluded in the construction of the monthly underpricing index due to unavailability of price information at the first day of trading, the number of offerings and offer sizes of the companies are still retained in the construction of monthly indices of issue volumes and values.

Table 4.11: Summarised Results for US IPOs with Missing Price Information Classified by Year

	No. of Offerings	Gross Proceeds per Year (US$ mil.)	Average Proceeds per Year (US$ mil.)
1976	4	10.8	2.7
1977	1	0.5	0.5
1978	5	1.7	0.3
1979	2	1.2	0.6
1980	3	3.7	1.2
1981	7	18.7	2.7
1982	N.A.	N.A.	N.A.
1983	4	9.8	2.5
1984	1	1.3	1.3
1985	8	108.7	13.6
1986	20	381.7	19.1
1987	4	13.5	3.4
1988	4	61.6	15.4
1989	5	25.1	5.0
1990	2	6.1	3.1
1991	N.A.	N.A.	N.A.
1992	1	1.2	1.2
1993	4	206.3	51.6
1994	3	20.6	6.9
1995	N.A.	N.A.	N.A.
1996	7	57.2	8.2
1997	8	635.8	79.5
1998	4	124.7	31.2
Overall	**97**	**1,690.2**	**17.4**

Note:
1. The data period is from 1974 to June 1998. Therefore, the figures for 1998 are only for the first half of the year.
2. N.A. denotes Not Available.

Table 4.12: Summarised Results for US IPOs with Missing Price Information Classified by Industry

	No. of Offerings	Gross Proceeds per Industry (US$ mil.)	Average Proceeds per Industry (US$ mil.)
Agriculture	1	156.6	156.6
Construction	2	77.1	38.6
Financial Institutions and Banks	28	462.5	16.5
Healthcare	2	2.4	1.2
Leisure	4	7.0	1.8
Manufacturing	18	201.1	11.2
Natural Resources	2	3.0	1.5
Personal, Business and Repair Services	15	164.5	11.0
Restaurants and Hotels	4	8.8	2.2
Retails	4	383.4	95.9
Telecommunication	4	199.4	49.9
Transportation	1	13.0	13.0
Wholesales	8	8.0	1.0
Unknown Industry	4	3.7	0.9
Overall	**97**	**1,690.2**	**17.4**

1. Financial Institutions and Banks include investment bankers, insurance, credit institutions, commercial banks, savings & loans, mortgage bankers, mortgage securities, and real estate.
2. Telecommunication includes telephone communications, television broadcasting, radio broadcasting and communication services.
3. Unknown industry means the industry classification is not defined by SDC.

4.3 Australian IPO Data[49]

4.3.1 *Data Sources and Collection Method*

The Australian IPO data covers all IPOs issued in Australia during the period January 1976 to June 1997.[50] Observations were obtained from various sources, such as SDC, the Australian Financial Review, Annual Reports of the Stock Exchange of Melbourne, the Companies Department Weekly Schedules (CDWS) published by the Australian Stock Exchange, and the Corporate Adviser IPO database. Details of data sources and collection method for various periods are described below.

4.3.1.1 January 1976 – December 1982

A list of all IPOs listed between January 1976 and December 1982 is obtained from *Annual Reports* of the Stock Exchange of Melbourne (published between 1976 and 1983). Names of issuing companies, total amount of funds raised and listing dates for all Australian IPOs listed between July of the previous year to June of the current year are collected. Offer prices and the number of shares issued are hand collected from various issues of *Jobson's Year Book of Public Companies of Australia and New Zealand* and *Jobson's Mining Year Book* between 1976 and 1983. Other information, such as industry classification and the

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[49] I would like to thank Frank Finn (University of Queensland), David Allen (Edith Cowan University), especially my supervisors, Tim Brailsford and Richard Heaney, for providing some Australian IPO data and information.

[50] While the US IPO data was collected in 1998, the Australian IPO data was collected in 1997. Therefore, Australian IPO data between July 1997 and June 1998 is not available in the analysis. To be consistent with the sample period for US IPOs, which enables a comparison analysis between the Australian and US IPO markets in a later chapter of the thesis, the Australian IPOs over the period 1974-1975 are excluded.

Australian Stock Exchange codes is found in the *Australian Stock Exchange Journal*. The closing prices on the first day of trading for the IPOs are obtained from Datastream International (DS), the core database of Australian Capital Markets Ltd and the *Australian Financial Review*.[51]

4.3.1.2 January 1983-December 1984

Financial information on all new listings between January 1983 and December 1984 is obtained from various issues of CDWS. This weekly publication contains information on offer price, number of shares issued, underwriter, industry classification, and the Australian Stock Exchange code for IPOs listed during the period. The closing price on the first day of trading is obtained from DS, the core database of Australian Capital Markets Ltd and the *Australian Financial Review*. The amount of funds raised for each IPO is collected from various issues of the *Annual Report* of the Stock Exchange of Melbourne.

The observations and their related financial information for the period are cross-checked with the relevant issues of *Annual Reports* obtained from the Stock Exchange of Melbourne and the *Australian Stock Exchange Journal*.

4.3.1.3 January 1985- December 1992

Data, in hard copy format (between 1985-1990), and electronic format (between 1991-1992) are obtained from the Corporate Advisor IPO database. This includes comprehensive IPO information on all new listings on the Australian

[51] Three companies have no trading prices on the first day of trading and the subsequent first trading month, although bid and ask quotes are available. A similar problem also exists in the US IPO data (see discussion on Implied Closing Price in Sub-section 4.2.1). To be consistent with the approach for the US data, the three companies with implied closing prices (implied from the bid-ask spread) are excluded from the construction of the monthly underpricing index but are included in the number of offerings and offer sizes for monthly indices.

Stock Exchange for the period, such as offer price, amount of funds raised, industry classification, closing price for the first day of trading and offer description. The information is checked against CDWS, ASX *Fact Books* and the *Annual Reports* of Stock Exchange. Missing information for some IPOs, such as offer price, closing price on the first day of trading, number of shares issued and industry classification are completed with reference to DS, the core database of Australian Capital Markets Ltd, the *Australian Financial Review*, and the *Australian Stock Exchange Journal*.

4.3.1.4 January 1993-June 1997

IPO data between January 1993 and June 1997 is collected in electronic format from SDC and is checked against various sources, such as ASX *Fact Book*, CDWS, ASX FinData Taxation Pack and the *Annual Stock Market Summaries* published by the Australian Stock Exchange. For observations with incomplete information, data are checked against DS, the core database of Australian Capital Markets Ltd and the *Australian Financial Review*.

4.3.2 Data Collection Issues for Australian IPOs

Three problems are found in the data collection procedure. First, some IPOs are offered to investors at various discriminating prices. Further, cross-checking of IPOs observed between 1985 and June 1998 revealed that SDC and the Corporate Adviser IPO database tend to use the highest discriminating price of an IPO as the offer price if a range of IPO prices exist. The highest discriminating price is verified to be more closely related to trading prices on the first day of trading and so in order to maintain consistency, offer prices selected for such companies are the highest discriminating prices.[52]

Second, three IPOs have no offer prices as reported in the CDWS.[53] As the study of hot issue IPO markets involves the construction of monthly underpricing index and offer price is a key component in calculating the initial return for each IPO and in calculation of gross proceeds for each individual IPO for Australian IPOs, these IPOs are removed from the sample.

Third, there are some differences in the industry classification systems between Australia and the USA. For the purpose of enabling a comparative analysis between the two markets, we convert the Australian ASX Industry Classification system into US Security Industry Classification system by the following method.

We first investigate industry and operating information of each Australian company based on the information provided in the *Jobson's Year Book of Public Companies of Australia and New Zealand* and *Jobson's Mining Year Book*. Each Australian company is then classified into an industry category under the US Security Industry Classification system based on their major industry activities. The details of converting the Australian ASX Industry Classification system into the US Security Industry Classification system are reported in Table 4.13. Obviously, some specification problems might exist. For instance, AMP Ltd is classified into the Insurance industry, but could also be classified into the Investment Banks industry.

[52] Note that this method might potentially bias against underpricing though any bias is expected to be small.
[53] These three companies fall in the years 1983 and 1984.

Table 4.13: Converting the Australian ASX Industry Classification system into the US Security Industry Classification System

US Security Industry Classification System	Australian ASX Industry Classification System
Agriculture	Agriculture, Pastoral, Fishing and Forestry.
Commercial Banks	State Banks and depository institutions.
Construction	Building Construction, Builders, Concrete, Miscellaneous Building, and Residential Development
Healthcare	Healthcare
Insurance	Insurance carriers and agents
Investment Banks	Equity Investment, security and commodity brokers
Leisure	Leisure and entertainment
Manufacturing	Alcohol and tobacco, electronic equipment, vintner and brewer, building product, can manufacturing, textile, metal and metal products, printing and publishing, machinery, chemical and plastic products, packaging, wood and furniture
Natural Resources	Oil and gas extraction, metal mining, coal mining and mineral exploration.
Other Financial Institutions and Banks	Real estate (or property) investment, other financial services, and miscellaneous financial services.
Other Services	Distribution services, video and records services.
Personal, Business and Repair Services	Miscellaneous industry services, other personal services, material supply, computer and office suppliers and services, industry services.
Restaurants and Hotels	Accommodation, resorts and restaurants.
Retails	Retail
Savings and Loans, Mutual Savings Banks	Building societies
Telecommunication	Telephone and television
Transportation	Transportation
Wholesales	Wholesale trade

Note: The table is only a general structure. The conversion of industry classification for Australian companies is investigated individually based on the industry and operating information of the companies provided in the *Jobson's Year Book Of Public Companies Of Australia and New Zealand* and *Jobson's Mining Year Book* for the period.

4.3.3 Final Australian IPO Sample

To ensure that only 'pure' common stock IPOs are included in the sample, the following criteria are employed:

a) The IPO must be a common stock IPO; issues involving debt, hybrid securities and derivatives are excluded

b) The IPO must be issued by an Australian-based company

c) Closed-end Mutual Funds, Investment Trusts and Real Estate Investment Trusts (REITs) are excluded due to their unique institutional set-up (see How and Low 1993)

d) Stock issues with embedded convertible notes, warrants, options or other financial instruments are excluded[54]

e) Companies formed through a Scheme of Arrangement are excluded due to the fact that a Scheme of Arrangement would normally result in a change of name and/or capital restructure of an existing listed company (How and Low 1993)

f) Companies transferred from the Second Board to the Main Board are excluded due to the reason that they are not unseasoned IPOs in the true sense as their stock has already been publicly listed.[55]

The above criteria are equivalent to those imposed on the US sample to ensure that the final samples for the two markets are consistent. This facilitates a comparison between the two markets.

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[54] There is no generic term for this kind of issue in Australia though they are equivalent to 'unit offerings' in the USA (details of unit offerings in the USA and the reasons for removing unit offerings are discussed in Section 4.2).

[55] The 'Second Board' market was first introduced in Australia in the early 1980s due to a growing recognition of the need to encourage smaller and less mature companies to list their shares through a 'Second Board' market. The listing requirements of this board were less stringent than those companies listed on the Main Board. The Second Board market disappeared after the introduction of the Stock Exchange Automated Trading System (SEATS) at the beginning of October 1990.

The final sample consists of 766 IPOs. The summary statistics of the sample are presented in the next sub-section.

4.3.4 Descriptive Statistics

4.3.4.1 By Year

Summarised results for IPOs classified by year are reported in Table 4.14. This table shows that the average initial return per year ranges from –3.52% in 1990 to 92.31% in 1994. The average initial return across all years is 37.09%. The average initial return appears to be quite volatile across the sample period with a weak cyclical trend.

The average initial return is higher than the reported average initial return of 11.9% in Lee et al. (1996a) and 29.2% in Finn and Higham (1988)[56] who both use Australian Industrial IPO data between 1976-1989 and 1966-1978, respectively. As their studies both focus on industrial IPOs, a cautious comparison needs to be made.[57] Further, Lee et al. (1996a) have a sample size of 266 Australian IPOs and Finn and Higham (1988) use 93 IPOs compared to the much larger sample of 766 IPOs used here. Our sample period is longer and substantially larger than both Finn and Higham (1988) and Lee et al. (1996a).

[56] It should be noted that the average initial return used in Finn and Higham (1988) was adjusted for market return.

[57] Some Australian natural resources companies show extremely high initial returns. For instance, the shares of Forrestania Gold company issued on 18 June 1987 reported an initial return of 1,120%.

Table 4.14: Summarised Results for Australian IPOs Classified by Year

Year	No of Offerings	Average Initial Return per Year	Gross Proceeds per Year (A$ mil.)	Average Proceeds per Year (A$ mil.)
1976	9	0.6731	87.6	9.7
1977	5	0.3379	34.0	6.8
1978	2	0.7000	15.0	7.5
1979	10	0.2935	56.1	5.6
1980	21	0.8733	145.9	7.0
1981	25	0.1637	312.6	12.5
1982	10	0.1431	486.7	48.7
1983	19	0.4966	73.9	3.9
1984	39	0.1772	323.8	8.3
1985	62	0.2684	564.4	9.1
1986	94	0.2799	1,029.4	11.0
1987	160	0.4092	2,520.9	15.8
1988	21	0.6196	328.4	15.6
1989	19	0.1723	393.2	20.7
1990	7	-0.0352	140.0	19.9
1991	10	0.0043	2,233.8	223.4
1992	33	0.0708	3,265.4	99.0
1993	62	0.2345	4,809.2	77.6
1994	70	0.9231	5,105.2	72.9
1995	20	0.1739	3,491.7	174.6
1996	42	0.1874	1,584.0	37.7
1997	26	0.5689	871.0	33.5
Overall	**766**	**0.3709**	**27,871.9**	**36.4**

Notes:

1. The figures for 1997 are only for half the year.
2. Average initial return is calculated as the return of the closing price on the first day of trading from the offer price averaged across IPOs.

The number of IPOs peaks in the mid-1980s (especially in 1986 and 1987). It then steps into decline with number of offerings falling gradually following the stock market crash of October 1987 and does not recover until 1992.

Gross proceeds per year increase sharply from A$140.0 million in 1990 to A$2,233.8 million in 1991 arising from an increased offer size during the period as indicated in the average proceeds per year.[58]

4.3.4.2 By Industry

Table 4.15 summarises the results for all the Australian IPOs by industry.[59] An important feature in the industry distribution of new issues is the relatively large proportion of offerings in the Natural Resources industry. There are a total of 244 natural resources companies in the sample (31.85% of the sample) with an average initial return of 46.46% and an average offer size of A$18.7 million. However, for the US sample, there are only 181 natural resource IPOs which comprise 2.7% of the full sample (see Table 4.2). Further, US natural resource IPOs exhibit an average initial return of 16.56% which is significantly lower than their Australian counterparts.

The Savings and Loans industry in Australia shows the highest initial return of 147.52% with the Transportation industry having the lowest initial return of 6.25%. In contrast, the US Savings and Loans industry shows an average initial

[58] The figures can be distorted by very large issues such as the Commonwealth Bank issue in 1991.

[59] Recall that the US industry classification scheme is used.

return of only 6.5% which is below the average initial return of the full US sample.

Table 4.15: Summarised Results for Australian IPOs Classified by US Industry Classification

	No. of Offerings	% of Total IPOs	Average Initial Return per Industry	Gross Proceeds per Industry (A$ mil.)	Average Proceeds per Industry (A$ mil.)
Agriculture	10	1.31%	0.1338	251.9	25.2
Commercial Banks	9	1.17%	0.4260	2,286.0	254.0
Construction	27	3.52%	0.2151	935.8	34.7
Healthcare	8	1.04%	0.1228	345.1	43.1
Insurance	8	1.04%	0.0856	1,909.0	238.4
Investment Banks	27	3.52%	0.0649	742.2	27.4
Leisure	15	1.96%	0.2261	2,035.4	135.7
Manufacturing	190	24.80%	0.5783	4,654.3	24.5
Natural Resources	244	31.85%	0.4646	4,572.4	18.7
Other Financial Institutions and Banks	56	7.31%	0.1842	1,375.9	23.7
Other Services	17	2.22%	0.2661	344.5	20.3
Personal, Business and Repair Services	95	12.40%	0.2096	1,361.4	13.9
Restaurants and Hotels	8	1.04%	0.2400	41.8	8.4
Retails	18	2.35%	0.0684	3,598.1	199.9
Savings and Loans	5	0.65%	1.4752	44.7	8.9
Telecommunication	11	1.44%	0.3098	886.2	80.6
Transportation	12	1.57%	0.0625	1,970.9	164.2
Wholesales	8	1.04%	0.3108	640.4	80.1
Overall	**766**	100.00%	**0.3709**	**27,871.9**	**36.4**

4.3.5 *Issues Related to Resource Sector IPOs in Australia*

Australia is recognised as a major source of natural resources and the stock exchange traditionally has contained a relatively large proportion of resource sector stocks compared to other exchanges. For instance, resource sector listings averaged 31% as a proportion of listed stocks over the period 1974-93 peaking at 41% in 1991 (see Table 4.16).

Ritter (1984b) argues that the 1980 hot issue markets in the USA arose from issues for Natural Resources and suggests that Natural Resources companies drive hot markets when natural resources firm values are high. How (1996) also argues that there is a differential behaviour in the resource sector IPOs in comparison with industrial sector IPOs. Therefore, the contentious nature of industry distributions between Australia and the USA provides an excellent base for further examination of the possible causes of hot issue markets. More importantly, the influence of resource sector IPOs in the IPO activity can be analysed using Australian data.

Given arguments concerning the potential differential behaviour and nature of the resource sector (How 1996; Ritter 1984b), the analysis of cyclical behaviour in the Australian IPO market (which appears later in this thesis) involves separate consideration of the industrial and resource sectors of the market.

Table 4.16: Distribution of Companies on the Official List of the Australian Stock Exchange

Year	Industrial	Mining	Total Listings	Mining as % of Total Listings
June 74	1,054	318	1,372	23.18%
June 75	1,024	302	1,326	22.78%
June 76	968	260	1,228	21.17%
June 77	920	239	1,159	20.62%
June 78	868	225	1,093	20.59%
June 79	797	226	1,023	22.09%
June 80	762	236	998	23.65%
June 81	689	285	974	29.26%
June 82	650	291	941	30.92%
June 83	604	297	901	32.96%
June 84	595	319	914	34.90%
June 85	610	359	969	37.05%
June 86	682	382	1,064	35.90%
June 87	868	475	1,343	35.37%
June 88	917	549	1,466	37.45%
June 89	811	506	1,317	38.42%
June 90	687	460	1,147	40.10%
June 91	597	415	1,012	41.01%
June 92	699	381	1,080	35.28%
June 93	703	407	1,110	36.67%

Data Source: *Annual Reports* of Stock Exchange of Melbourne (1974-1988) and The *Australian Stock Exchange yearbook* 1994 (1989-1993).

4.4 Summary and Conclusion

In this chapter, IPO data sources and collection method are reported. Descriptive analysis of the Australian and US IPO data is also presented. The analysis in this chapter suggests that the US companies with implied closing prices and with missing price information have relatively small offer sizes with most of them in the industries of Personal, Business and Repair Service and Manufacturing. There is a significant difference in underpricing between unit and stock offerings in the USA, although the results obtained from parametric tests are somewhat mixed. There is support for the decision to eliminate unit offerings from the sample.

The Australian new issue market exhibits a relatively high initial return, on average, relative to the US IPO market. Moreover, the average initial return per year appears to be quite volatile when compared to the US results. Natural Resources companies in Australia form a relatively large proportion of total IPO issuance in the sample period and this is an important feature of the Australian IPO market. They are characterised by relatively higher initial returns and smaller offer sizes compared with IPOs in other industries.

CHAPTER FIVE

MEASURING IPO ACTIVITY

5.1 Introduction

In this thesis, I focus on the aggregate IPO market to examine the cycles in both Australian and the US IPO activities. An aim is to examine the existence of cycles in the IPO activity using a long time-series and to analyse the relationships between various indicator variables during these periods. Therefore, measures of IPO activity are necessary.

In the literature, the level of IPO activity has been generally examined through two broad measures being volume and underpricing of IPOs. Consistent with these traditional measures, four measures of IPO activity are developed in this chapter which capture both volume and underpricing aspects of the market. A time series of IPO issues from 1976 to June 1997 for Australia and from 1976 to June 1999 for the USA are constructed for analysis. The construction of these measures and their summary statistics are discussed in this chapter.

5.2 Measures of IPO Activity

A hot issue IPO market is generally characterised by an unusually high volume of new offerings, severe underpricing, and frequent oversubscription of offerings (Ritter 1998; Helwege and Liang 1996a). As noted above, the level of IPO activity has traditionally been viewed in terms of two measures - a volume measure such as the number of new issues (Loughran et al. 1994; Ritter 1984b) and a pricing measure such as the average level of underpricing (Ibbotson and Jaffe 1975; Ritter 1984b). Consistent with these measures, we develop four variables that measure these aspects of IPO activity. Two of the variables measure volume while the other two measure underpricing. Each variable is measured on a monthly basis.[60]

5.2.1 *Volume Measures*

NOIPO is measured as the number of offerings in a month divided by total number of IPOs over the sample period expressed as a percentage. Hence it seeks to measure the relative number of issues in each month. It is the simplest measure and is consistent with previous literature that has examined the number of IPOs (e.g. Ibbotson et al. 1994; Loughran et al. 1994). NOIPO is represented as:[61]

$$NOIPO_t = \frac{N_t}{\sum_{t=1}^{T} N_t} * 100 \qquad (1)$$

where

N_t = the number of IPOs in month t;

t = month 1,2, …, T where T=270 for US IPOs and is 258 for Australian IPOs.

GP is measured as the sum of individual issue proceeds in each month (adjusted for inflation) divided by total proceeds (adjusted for inflation) of all

[60] This is the shortest sampling interval to which data can be feasibly disaggregated.
[61] Since the IPO underpricing measures defined later are expressed as a percentage, NOIPO and GP are thus scaled by the total number of offerings and total proceeds during the period in order to maintain the consistency in the measures.

IPOs in the sample period expressed as a percentage.[62] This measure is also a relative measure and captures the monthly variation in total size of the issues. The measure is expressed as:

$$GP_t = \frac{\sum_{i=1}^{N}(proceeds)_{i,t}}{\sum_{t=1}^{T}\sum_{i=1}^{N}(proceeds)_{i,t}} \qquad (2)$$

where

i = company 1, 2, …, N where N is the number of IPOs in month t;

$(proceeds)_{i,t}$ = [(number of shares issued)$_{i,t}$ * (inflation adjusted offer price)$_{i,t}$].

5.2.2 *Underpricing Measures*

VWUP is a measure of underpricing weighted by the relative size of the offer in each month. Hence, large underpricing observed in small companies in a particular month will not significantly affect this measure. Measures of underpricing have been criticised as they can be subject to too much influence by 'penny' stocks (Ibbotson and Ritter 1995). Indeed, the hot market of 1980 has been ascribed to small natural resource issues (Ritter 1984b). However our measure avoids this criticism by accounting for differences in firm/issue size within the month.[63] VWUP is calculated as follows:

[62] The inflation adjustment is performed as the level of IPO activity divided by an inflation index, where the inflation index is measured each month using January 1976 as the base month. The US inflation rate data are obtained from the Federal Reserve Bank of St Louis while the Australian inflation rate data are obtained from the Australian Bureau of Statistics.

[63] A monthly index of equal weighted underpricing is also constructed. This index is highly correlated with the value weighted underpricing index for both Australian and US IPO data (e.g. a correlation of 0.895 is observed using US IPOs).

$$VWUP_t = \frac{\sum_{i=1}^{N} (\text{proceeds})_{i,t} \times (\text{IPO Underpricing})_{i,t}}{\sum_{i=1}^{N} (\text{proceeds})_{i,t}} \times 100 \qquad (3)$$

where

(IPO Underpricing)$_{i,t}$ = [(closing price on first day trading)$_{i,t}$ – (offer price)$_{i,t}$] / (offer price)$_{i,t}$

The other underpricing measure, VUP, is also a value-weighted measure.[64] However, this measure standardises by the total value of underpricing across the sample whereas VWUP standardises by size within each month. VUP represents the proportion of total value generated through underpricing across the sample realised in each month and is defined as:

$$\text{VUP}_t = \frac{\sum_{i=1}^{N} (\text{proceeds})_{i,t} \times (\text{IPO Underpricing})_{i,t}}{\sum_{t=1}^{T} \sum_{i=1}^{N} (\text{proceeds})_{i,t} \times (\text{IPO Underpricing})_{i,t}} \times 100 \qquad (4)$$

5.3 Summary Statistics

Summary statistics of the IPO activity measures for both the Australian and US samples are reported in this section.

5.3.1 US IPOs

5.3.1.1 Summary Statistics

Summary statistics on the four US IPO activity measures are reported in Table 5.1. The relative number of IPOs (NOIPO) has a mean value of 0.37% and a

[64] An inflation adjustment is also applied on VUP.

standard deviation of 0.30%. The monthly NOIPO ranges from a low of zero (i.e. no issues) to a monthly high of 1.36%. Similarly, the relative proportion of gross proceeds (GP) ranges from zero to 2.11% with a mean of 0.37% and a standard deviation of 0.40%.

Table 5.1: Summary Statistics of Measures of US IPO Activity 1976-June 1998

	NOIPO	GP	VWUP	VUP
Mean	0.370	0.370	8.667	0.370
Standard Deviation	0.301	0.402	9.422	0.609
Minimum	0.000	0.000	-15.556	-0.206
Maximum	1.357	2.113	70.383	4.803
Dickey-Fuller Test Statistic	-2.88*	-2.87*	-6.44*	-3.39*
Autocorrelation				
Lag 1	0.802*	0.728*	0.517*	0.757*
Lag 2	0.727*	0.608*	0.370*	0.559*
Lag 3	0.692*	0.573*	0.142*	0.543*
Lag 4	0.662*	0.581*	0.089*	0.544*
Lag 5	0.606*	0.575*	0.080*	0.594*
Lag 6	0.553*	0.602*	0.133*	0.567*

Notes:
1. GP and VUP are adjusted for inflation.
2. * denotes significance at 5% level.
3. Note the means for NOIPO, GP and VUP are a proportional function over the sample period.

The underpricing figures exhibit greater volatility, as expected. The average VWUP per month is 8.67%. Hence, as expected, larger issues are less underpriced, as evidenced by this figure which is lower than the simple sample average of 10.19% (See Table 4.1 in Chapter 4). Monthly VWUP ranges from an underpricing of 70.38% to an overpricing of 15.56%. The standard deviation of VUP is 0.61% with a range between –0.21% to 4.80%.

Autocorrelation tests up to 6 lags identify strong statistically significant correlation for all the US IPO activity measures. The first-order autocorrelation for

NOIPO is 0.80 and is 0.52 for VWUP. These results are quite consistent with prior research which has demonstrated persistence in these series (Ibbotson et al. 1994; Ritter 1998). For instance, Ibbotson et al. (1994) observe a first-order autocorrelation of 0.88 for the monthly number of new issues and 0.62 for the monthly equally-weighted initial return.

5.3.1.2 Stationarity Issue

Since a Markov regime switching technique is applied in the later chapters to detect hot and cold issue periods in the series, the stationarity of each series is an important requirement for application of the technique (Hamilton 1994). If a series is non-stationary, it is often necessary to transform the series into a stationary process (e.g. first differencing) for analysis. Generally, the stationarity of a series can be checked by finding out if the series contains a unit root and a popular test is the Dickey-Fuller test. Hence, each IPO activity measure is examined for stationarity using the Dickey-Fuller test.

In the sixth row of Table 5.1, test statistics from the Dickey-Fuller test for stationarity are presented and these results suggest that the four series are all stationary.

5.3.1.3 Graphical Presentations of the Series

Figures 5.1 to 5.4 present graphs of the four measures of IPO activity. In Figure 5.1, NOIPO shows a clear pattern of hot and cold periods prior to 1991 with spikes around 1981, 1984, 1987 and around 1997. It appears that the series is generally in a cold issue period between 1975-1980. The first hot issue period starts around 1980 and ends in 1982. Between 1988 and 1990, the series appears to be in a cold period which indicates the adverse impact of the 1987 market crash. The NOIPO becomes more volatile after 1991 but appears to be in a hot state over this period.

Figure 5.1: NOIPO during the period of 1976 and June 1998 in the USA

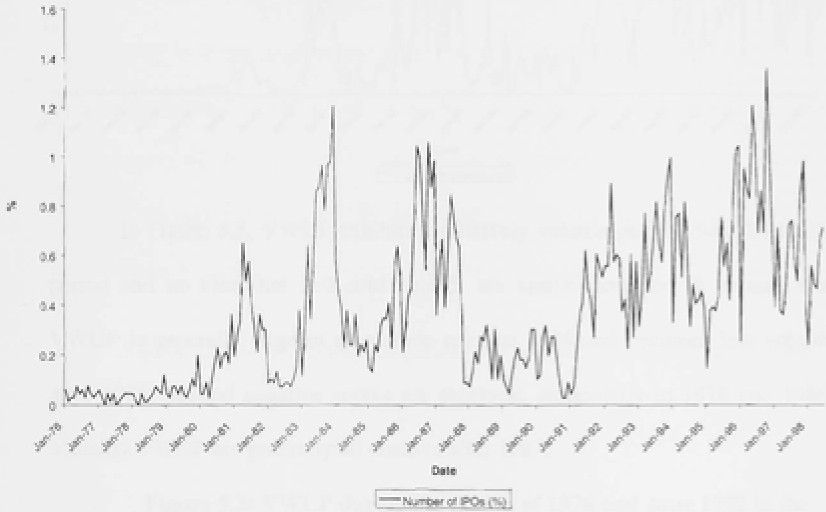
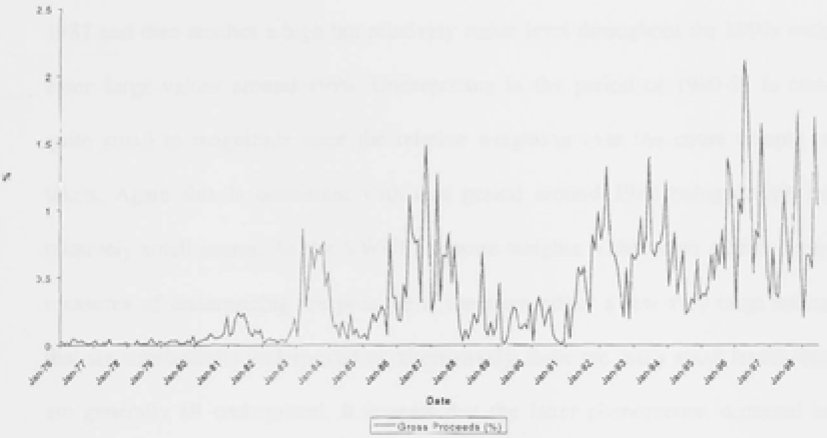


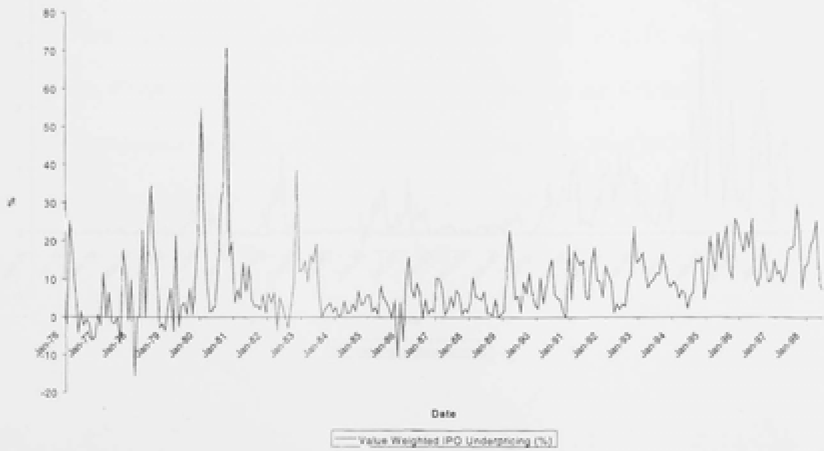
Figure 5.2 shows that the GP series follows a similar pattern to that of the NOIPO series, especially after 1986. Between 1976 and 1980, GP exhibits a relative stable pattern and appears to be in a cold state. However, the series becomes more volatile after 1980. Of note is the period 1980-81 which is generally much smaller in magnitude than NOIPO. While GP takes into account the size of offering and NOIPO does not, this observation supports Ritter's (1984b) conjecture that this period around 1980 was driven by a relatively large number of small issues.

Figure 5.2: GP during the period of 1976 and June 1998 in the USA



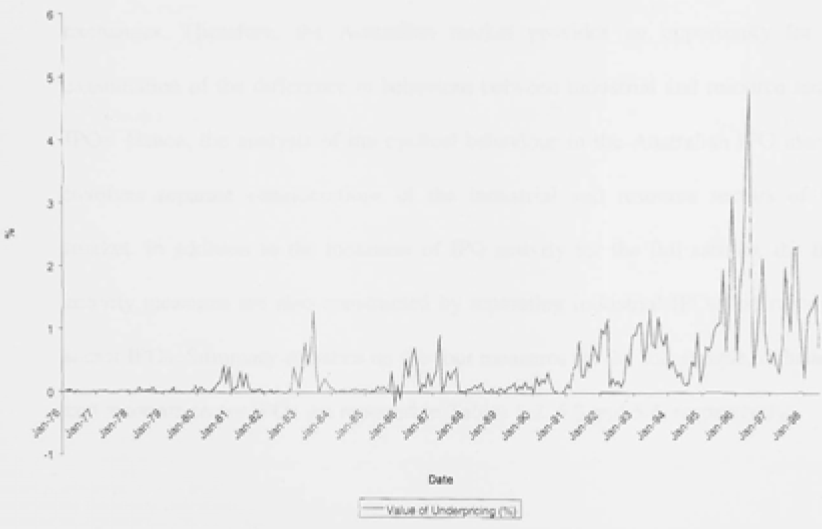
In Figure 5.3, VWUP exhibits a relatively volatile pattern over the whole period and no clear hot and cold periods are easily identified. It appears that VWUP is generally large in magnitude prior to 1984 and becomes less volatile after 1985. Several negative spikes are observed, particularly in 1978 and 1986. Monthly VWUP are generally all positive after 1987.

Figure 5.3: VWUP during the period of 1976 and June 1998 in the USA



In Figure 5.4, the pattern of VUP is more consistent with the volume measures than VWUP. The series exhibits some small spikes around 1983 and 1987 and then reaches a high but relatively stable level throughout the 1990s with some large values around 1996. Underpricing in the period of 1980-81 is now quite small in magnitude once the relative weighting over the entire sample is taken. Again this is consistent with that period around 1980 being driven by relatively small issues. As the VWUP measure weights within each month, large measures of underpricing are possible if there are either a few very large issues that are substantially underpriced or, alternatively, there are many small issues that are generally all underpriced. It appears that the latter phenomenon occurred in 1980-81. Of note, while VUP is broadly similar to the volume series, spikes in this series appear to lead spikes in the volume series by up to a year.

Figure 5.4: VUP during the period of 1976 and June 1998 in the USA



The two underpricing series in Figures 5.3 and 5.4 reveal some interesting features. First, casual observation shows that neither of the underpricing series tracks the volume measures in Figures 5.1 and 5.2 particularly well. Hence there appears to be a difference in behaviour between volume and underpricing. Second, the two underpricing series themselves exhibit differences. Figure 5.3 plots the VUWP series and reveals large spikes around 1979, 1980, 1981, 1983 and generally a high level of underpricing from around 1989 onward. The spikes around 1980-81 may be surprising, but can be explained because this measure weights by the relative size of the issue within each month.

5.3.2 Australian IPOs

As stated in Chapter four, the Australian stock exchange traditionally has contained a relatively large proportion of resource sector stocks compared to other exchanges. Therefore, the Australian market provides an opportunity for an examination of the difference in behaviour between industrial and resource sector IPOs. Hence, the analysis of the cyclical behaviour in the Australian IPO market involves separate considerations of the industrial and resource sectors of the market. In addition to the measures of IPO activity for the full sample, the IPO activity measures are also constructed by separating industrial IPOs and resource sector IPOs. Summary statistics on the four measures for the full sample, industrial and resource sector IPOs are reported in Tables 5.2, 5.3 and 5.4, respectively.

5.3.2.1 Full Australian Sample

Table 5.2 reports the summary of each measure for all Australian IPOs. While the proportion of the number of IPOs per month ranges from a low of zero to a monthly high of 3.00%, the relative proportion of gross proceeds ranges from zero to 8.51%. Standard deviations for NOIPO and GP are 0.51% and 0.87%, respectively. These figures are higher than in the US market which implies that the volume measures in Australia are more volatile.

With a mean value of 21.97% and a standard deviation of 50.86%, VWUP ranges from an overpricing of 82.00% to an underpricing of 541.64% per month. VUP appears to be less volatile than VWUP as indicated by its standard deviation (1.17%) and its range (–0.43% and 9.97%).

Table 5.2: Summary Statistics of Australian IPO Activity
Jan 1976 - June 1997

	NOIPO	GP	VWUP	VUP
Mean	0.388	0.388	21.974	0.388
Standard Deviation	0.505	0.874	50.855	1.169
Minimum	0.000	0.000	-82.000	-0.425
Maximum	3.003	8.507	541.636	9.969
Dickey-Fuller Test Statistic	-3.633*	-5.089*	-7.684*	-7.620*
Autocorrelation				
Lag 1	0.760*	0.238*	-0.075	0.048
Lag 2	0.662*	0.176*	-0.003	0.030
Lag 3	0.584*	0.192*	0.055	0.028
Lag 4	0.529*	0.246*	-0.013	-0.011
Lag 5	0.481*	0.114*	0.014	0.064
Lag 6	0.462*	0.053*	0.050	-0.011

1. GP and VUP are adjusted for inflation.
2. Due to insufficient information, there are two missing values in both VUP and VWUP and one missing value in GP.
3. * denotes significance at 5% level.
4. Note the means for NOIPO, GP and VUP are a proportional function over the sample period.

Of note, the ranges for all measures are greater in Australia than in the USA which suggests that the Australian IPO market is more volatile than the US market. In Table 5.2, test statistics from the Dickey-Fuller test suggest that all four series are stationary.

By checking the autocorrelation tests for all the series, it appears that statistically significant correlation is only observed in the IPO volume measures. Compared with the US IPO volume measures, the autocorrelations in the Australian NOIPO are similar to that of the US, while the autocorrelations in Australian GP are much lower though they are statistically significant. Of note, the autocorrelations of both the IPO underpricing measures reveal mixed signs. For instance, the first, second and fourth lags of VWUP are negative while the rest of lags of VWUP are positive. This suggests that the behaviour of aggregate IPO underpricing measures in Australia differs. This may be due to the relatively large proportion of resource sector IPOs in Australian new issues.

Figures 5.5 to 5.8 present graphs of the four measures of Australian IPO activity over the period 1976 to June 1997. In Figure 5.5, NOIPO shows a clear pattern of hot and cold periods in the periods around 1985-1987 and 1993-1995 though other hot and cold periods cannot be clearly identified for the rest of period. Compared with Figure 5.1, NOIPO in Australia appears to exhibit some correlation with NOIPO in the USA, especially in the periods around 1985-1987 and 1993-1995.

Figure 5.5: NOIPO during the period of 1976 and June 1997 in Australia

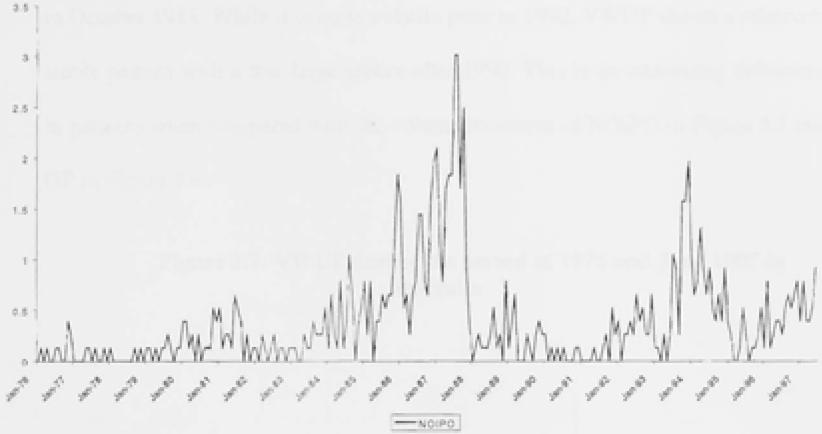


Figure 5.6 shows GP is generally small in amplitude prior to 1991 and becomes more volatile with some extremely large spikes after 1991. This may be explained by government privatisation of some large public institutions during the period, such as the Commonwealth Bank and Qantas. Compared with Figure 5.5, GP shows a weak correlation in pattern to that of NOIPO. Compared with GP in the USA (see Figure 5.2), Australian GP shows a similar cold issue period prior to 1980 and a similar hot issue period between 1991 and 1995 with slight deviations.

Figure 5.6: GP during the period of 1976 and June 1997 in Australia

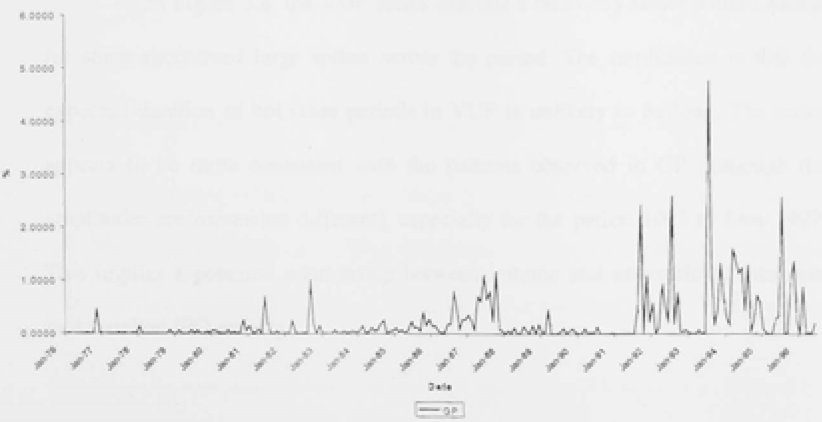
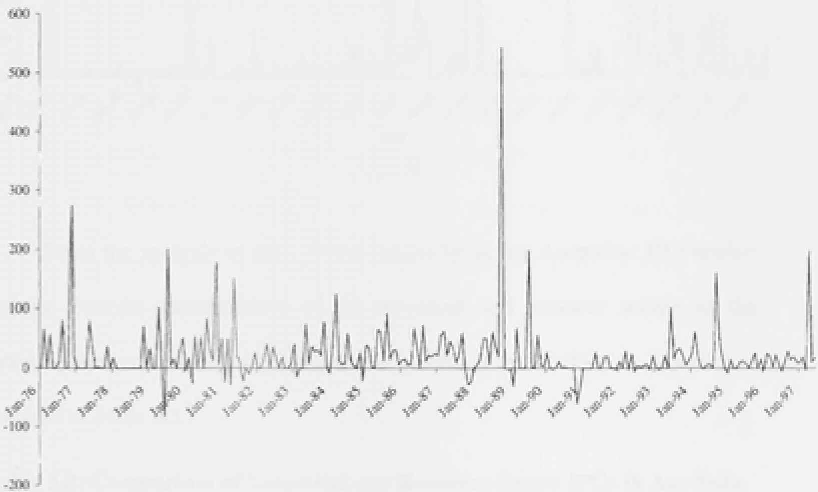


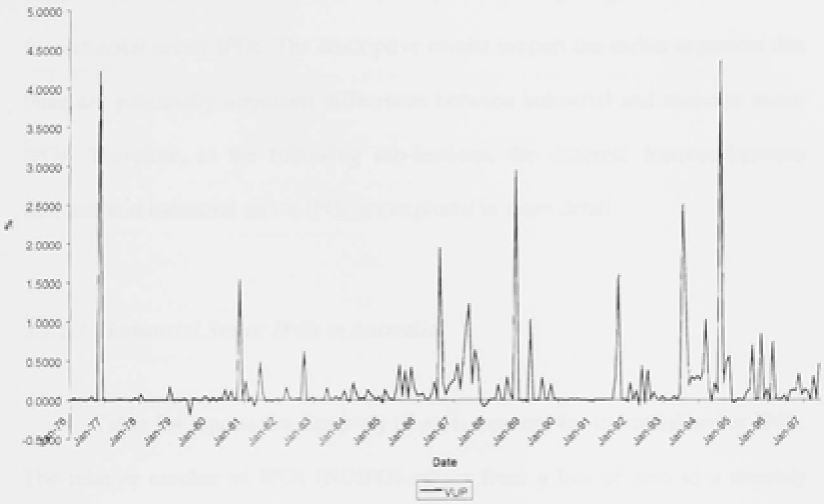
Figure 5.7 plots the VUWP series which reveals an extremely large spike in October 1988. While it is quite volatile prior to 1990, VWUP shows a relatively stable pattern with a few large spikes after 1990. This is an interesting difference in patterns when compared with the volume measures of NOIPO in Figure 5.5 and GP in Figure 5.6.

Figure 5.7: VWUP during the period of 1976 and June 1997 in Australia



From Figure 5.8, the VUP series exhibits a relatively stable pattern except for some short-lived large spikes across the period. The implication is that the expected duration of hot issue periods in VUP is unlikely to be long. The series appears to be more consistent with the patterns observed in GP (although the amplitudes are somewhat different), especially for the period 1992 to June 1997. This implies a potential relationship between volume and underpricing measures in Australian IPO activity.

Figure 5.8: VUP during the period of 1976 and June 1997 in Australia



Since the analysis of the cyclical behaviour in the Australian IPO market involves separate considerations of the industrial and resource sectors of the market, a brief comparison of resource and industrial sector IPOs in Australia is presented in Table 5.3.[65]

Table 5.3: Comparison of Industrial and Resource Sector IPOs in Australia

	Average Initial Return	Gross Proceeds (A$ mil.)	Average Proceeds (A$ mil.)	No. of Offerings	% of Total IPOs
Industrial Sector IPOs	0.2333	23,424	44	522	68.15%
Resource Sector IPOs	0.4646	4,572	19	244	31.85%
Overall	0.3709	27,872	36	766	100%

There are a total of 244 new issues in the resource sector over the sample which represents 31.85% of all IPOs. While the average initial return for industrial sector IPOs is 23.33%, the average initial return for resource sector IPOs is almost

[65] Further detail of the industry break-up of the sample can be found in Chapter 4 (see Table 4.15).

double with a value of 46.46%. In relation to the average offer size, the figure is A$19 million for resource sector IPOs compared to a larger figure of A$44 million for industrial sector IPOs. The descriptive results support the earlier argument that there are potentially important differences between industrial and resource sector IPOs. Therefore, in the following sub-sections, the different features between resource and industrial sector IPOs are explored in more detail.

5.3.2.2 Industrial Sector IPOs in Australia

Table 5.4 reports the summary of each measure for industrial sector IPOs. The relative number of IPOs (NOIPO) ranges from a low of zero to a monthly high of 3.26%. While the minimum value is zero, the maximum value of GP is 10.34%. Compared with the full sample of Australian IPOs, NOIPO in the industrial sector shows quite similar results while GP in the industrial sector appears to be more volatile as indicated by its range and standard deviation.

The mean value of VWUP is 15.92% with a standard deviation of 34.92%. While VWUP ranges from an overpricing of 66.00% to an underpricing of 277.55%, the range for VUP is between –0.30% to 11.03%. Of note, VWUP exhibits a lower mean value (15.92%) and standard deviation (34.92%) compared to the full sample. The implication is that industrial sector IPOs exhibit lower underpricing than resource sector IPOs.

Table 5.4: Summary Statistics of IPO Activity in the Australian Industrial Sector

January 1976 - June 1997

	NOIPO	GP	VWUP	VUP
Mean	0.388	0.389	15.916	0.391
Standard Deviation	0.544	1.033	34.916	1.078
Minimum	0.000	0.000	-66.000	-0.295
Maximum	3.263	10.344	277.548	11.029
Dickey-Fuller Test Statistic	-3.553*	-5.265*	-6.695*	-6.636*
Autocorrelation				
Lag 1	0.683*	0.216*	0.265*	0.054
Lag 2	0.622*	0.153*	0.076*	0.057
Lag 3	0.561*	0.154*	0.047*	0.024
Lag 4	0.514*	0.236*	0.071*	0.030
Lag 5	0.486*	0.122*	0.052*	-0.032
Lag 6	0.502*	0.061*	0.080*	0.031

Note:

1. GP and VUP are adjusted for inflation.
2. Due to insufficient information, there is one missing value in GP, two in VUP and three in VWUP.
3. * denotes significance at 5% level.
4. Note the means for NOIPO, GP and VUP are a proportional function over the sample period.

Compared to the autocorrelation results obtained for the Australian full sample, the industrial sector IPOs now exhibit significantly positive correlations for VWUP in addition to NOIPO and GP. The first-order autocorrelation in VWUP is 0.27 and is much higher than other high-order autocorrelations which are generally less than 0.08. This confirms that resource sector IPOs have a significant influence on the full sample underpricing measures. Of note, autocorrelation tests exhibit no significant correlation for VUP of the industrial sector IPOs which is consistent with the results obtained in the full sample.

The results of the Dickey-Fuller test are presented in the sixth row of Table 5.4 and they suggest that all measures are stationary.

Figures 5.9 to 5.12 present graphs of the four measures of Australian industrial sector IPO activity during the period 1976 to June 1997. Both volume measures exhibit a consistent pattern with the corresponding volume measures in the full sample (see Figures 5.9 and 5.10). For instance, industrial IPOs exhibit a peak in NOIPO between 1985-1987 and this is consistent with the pattern in the NOIPO of the full sample. However, the underpricing series in Figures 5.11 and 5.12 show little correlation with the underpricing measures in the full sample.

Compared with the full sample, the pattern of VWUP for industrial sector IPOs is quite different in the 1990s. Despite some variability in the amplitudes, the VUP of industrial IPOs is more consistent with the full sample, especially in the period 1992 to June 1997.

Figure 5.9: NOIPO of the Australian Industrial Sector IPOs during the period of 1976 and June 1997

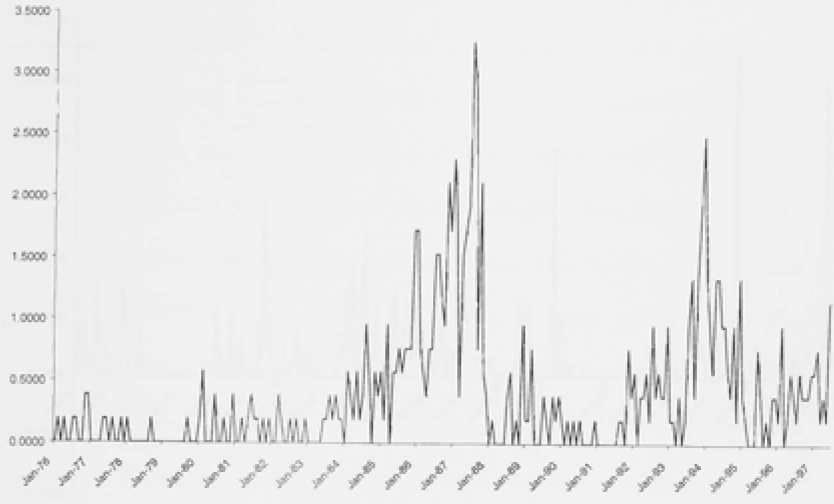


Figure 5.10: GP of the Australian Industrial Sector IPOs during the period of 1976 and June 1997

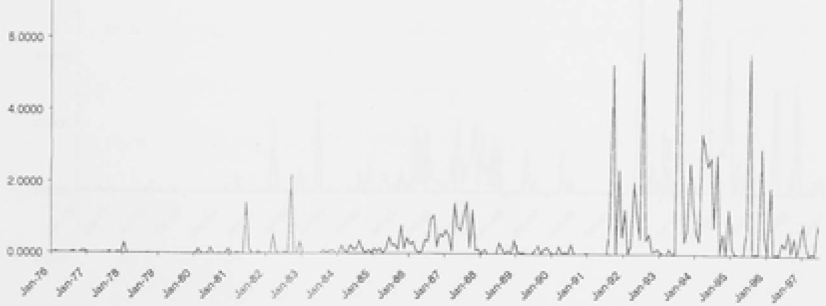


Figure 5.11: VWUP of the Australian Industrial Sector IPOs during the period of 1976 and June 1997

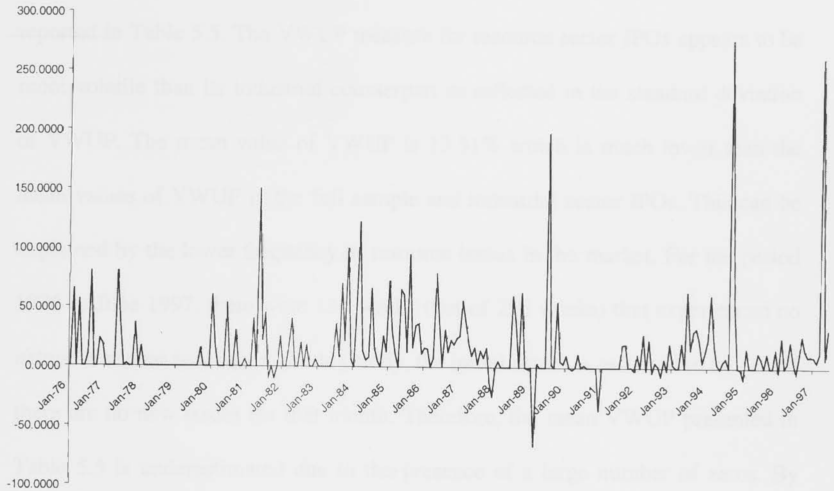
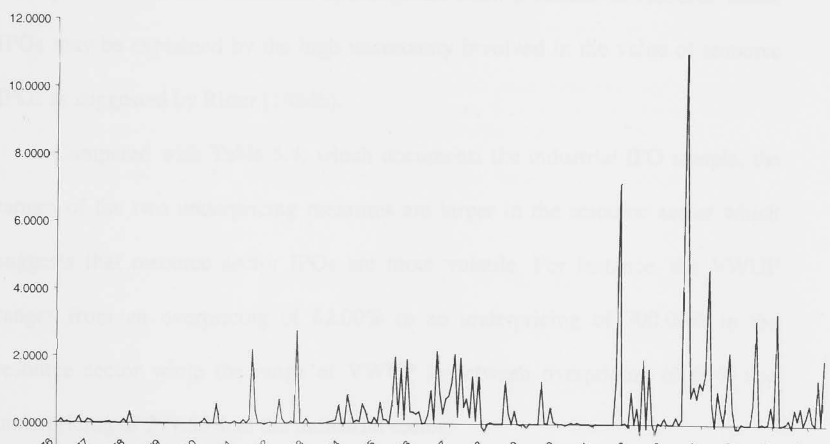


Figure 5.12: VUP of the Australian Industrial Sector IPOs during the period of 1976 and June 1997



5.3.2.3 Resource Sector IPOs in Australia

Summary statistics of each measure for Australian resource sector IPOs are reported in Table 5.5. The VWUP measure for resource sector IPOs appears to be more volatile than its industrial counterpart as reflected in the standard deviation of VWUP. The mean value of VWUP is 13.51% which is much lower than the mean values of VWUP in the full sample and industrial sector IPOs. This can be explained by the lower frequency of resource issues in the market. For the period 1976 to June 1997, there were 138 weeks (out of 258 weeks) that experienced no natural resource new issues. In this study, the initial return is assumed to be zero if there are no new issues for that month. Therefore, the mean VWUP presented in Table 5.5 is underestimated due to the presence of a large number of zeros. By excluding those months with no resource issues, the average VWUP rises to 29.53%. This supports our argument above that resource IPOs are more underpriced than their industrial counterparts. Such a feature in resource sector IPOs may be explained by the high uncertainty involved in the value of resource IPOs as suggested by Ritter (1984b).

Compared with Table 5.4, which documents the industrial IPO sample, the ranges of the two underpricing measures are larger in the resource sector which suggests that resource sector IPOs are more volatile. For instance, the VWUP ranges from an overpricing of 82.00% to an underpricing of 700.00% in the resource sector while the range of VWUP is between overpricing of 66% and underpricing of 277.55% in the industrial sector.

Table 5.5: Summary Statistics of IPO Activity in the Australian Resource Sector
January 1976 - June 1997

	NOIPO	GP	VWUP	VUP
Mean	0.388	0.388	13.513	0.388
Standard Deviation	0.605	1.173	57.436	2.155
Minimum	0.000	0.000	-82.000	-2.077
Maximum	3.279	9.749	700.000	24.970
Dickey-Fuller Test Statistic	-4.407*	-7.047*	-7.629*	-8.169*
Autocorrelation				
Lag 1	0.576*	0.063	-0.017	0.004
Lag 2	0.430*	0.020	0.015	-0.002
Lag 3	0.392*	0.001	0.028	-0.005
Lag 4	0.355*	0.078	0.009	-0.030
Lag 5	0.355*	0.081	0.092	0.045
Lag 6	0.255*	0.013	0.010	-0.017

Note:
1. GP and VUP are adjusted for inflation.
2. There were 138 weeks (out of 258 weeks) that had no new issue in the Resource Sector. In this study, the initial return for the month is assumed to be zero if there is no IPO for the month. By excluding the months that had no IPO, the mean value of VWUP is 29.53%.
3. * Denotes significance at 5% level.
4. Note the means for NOIPO, GP and VUP are a proportional function over the sample period.

The autocorrelation results for all series reveal interesting results. Only NOIPO exhibits significant correlations while all others are insignificant. This implies that apart from the number of resource IPOs, the other series appear to be random and unpredictable.

Graphs of the four measures of IPO activity in resource sector IPOs are presented in Figures 5.13 to 5.16. Compared with the full sample and industrial sector IPOs, the two volume measures exhibit generally consistent patterns (see

Figures 5.13 and 5.14). This suggests that volume in both industrial and resource issues follow a general trend. However, the patterns of the two underpricing measures in resource sector IPOs appear to have little correlation with the patterns observed in either the full sample or the industrial sector. For instance, large spikes in VUP between 1992-1997 for both full sample and industrial sector IPOs are not found in the VUP of resource sector IPOs. Also, the period between 1977-1978 appears to be in a hot state for both full sample and industrial IPOs while the period appears to be in a cold state for resource sector IPOs (see Figures 5.15 and 5.16).

Several implications follow. First, the volume in both the industrial and resource sectors appears to follow a similar general trend. This is supported by the visual evidence that the patterns observed in the volume measures for both industrial and resource sector IPOs are consistent with the full sample and also generally consistent with each other. Second, the degree of underpricing in resource sector IPOs appears to be less stable as evidenced by a lower persistence in spikes of VUP. Moreover, the degree of underpricing is larger in resource sector IPOs.

Figure 5.13: NOIPO of the Australian Resource Sector IPOs during the period of 1976 and June 1997

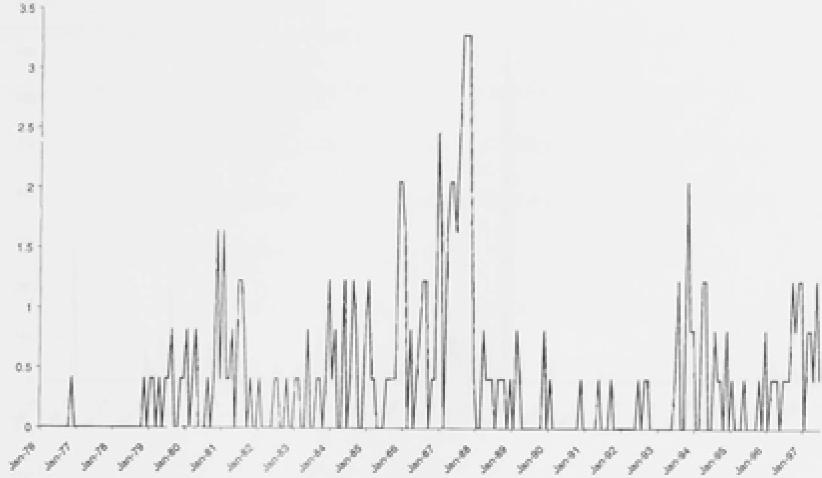


Figure 5.14: GP of the Australian Resource Sector IPOs during the period of 1976 and June 1997

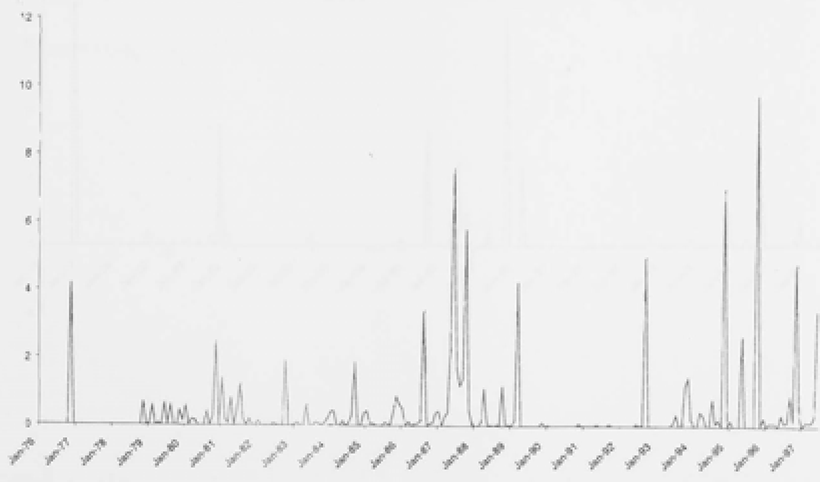


Figure 5.15: VWUP of the Australian Resource Sector IPOs during the period of 1976 and June 1997

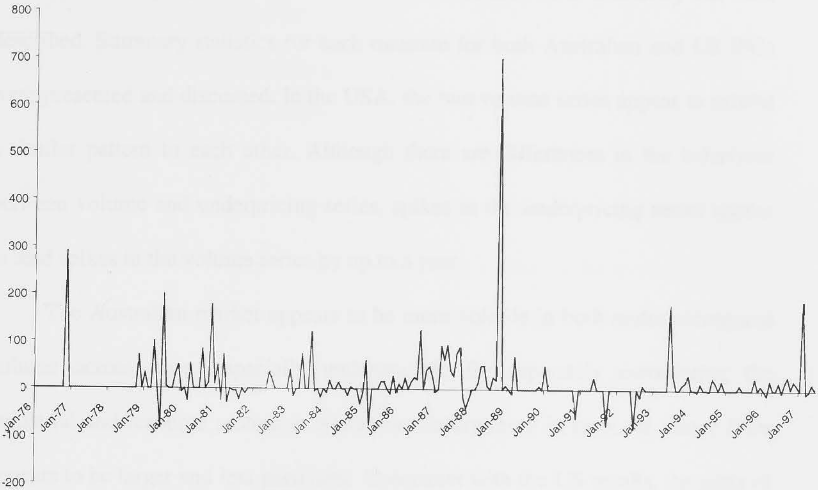
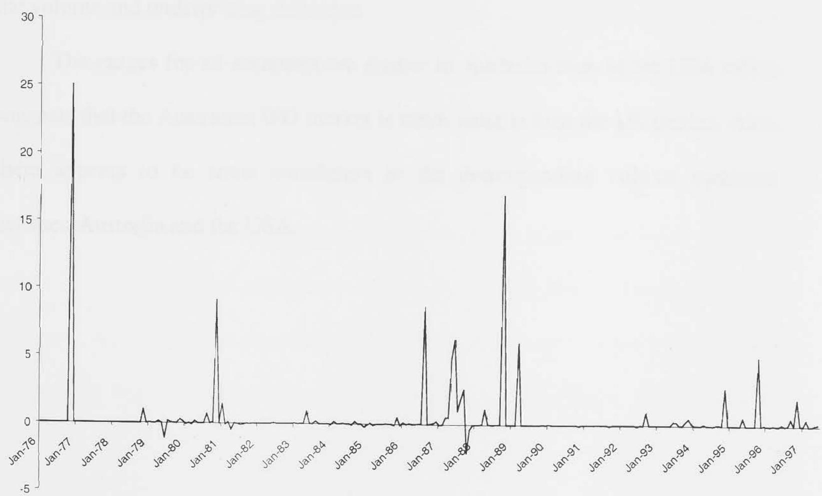


Figure 5.16: VUP of the Australian Resource Sector IPOs during the period of 1976 and June 1997



5.4 Summary

In this chapter, the construction of four measures of IPO activity has been described. Summary statistics for each measure for both Australian and US IPOs were presented and discussed. In the USA, the two volume series appear to exhibit a similar pattern to each other. Although there are differences in the behaviour between volume and underpricing series, spikes in the underpricing series appear to lead spikes in the volume series by up to a year.

The Australian market appears to be more volatile in both underpricing and volume across time, especially underpricing. By separately considering the industrial and resource sectors in Australia, underpricing in resource sector IPOs appears to be larger and less persistent. Consistent with the US results, the plots of Australian IPO activity measures suggest a potential lead-lag relationship between the volume and underpricing measures.

The ranges for all measures are greater in Australia than in the USA which suggests that the Australian IPO market is more volatile than the US market. Also, there appears to be some correlation in the corresponding volume measures between Australia and the USA.

CHAPTER SIX[66]

HOT AND COLD IPO MARKETS: US EVIDENCE

6.1 Introduction

As argued earlier in Chapter three, there is mounting evidence to support the existence of hot IPO markets. However, the existing evidence is generally based on descriptive ex-post analysis. The questions of how frequent the hot issue markets are, what features are associated with these markets and dating when they occur, remain to be answered.

In this chapter, I focus on hot and cold IPO markets in the USA. The aim is to document the existence of hot and cold markets in the USA using a long time-series of IPO data and to examine the relationships between various IPO activity variables during these cycles. I identify turning points in IPO activity using both visual analysis and a dating algorithm developed by Bry and Boschan (1971). A regime-switching model is then fitted to allow for more precise identification of episodes in the market.

In brief, the results confirm the existence of hot periods across all measures of IPO activity. As these measures capture different characteristics of the IPO market, I document that hot issue periods can be differentiated. Moreover, I examine the

[66] The material in this chapter has been condensed and edited into a paper, titled "Hot and Cold IPO Markets", which has been accepted for publication in the *Multinational Finance Journal*. In addition to my supervisors, Tim Brailsford and Richard Heaney, I would like to acknowledge the comments and suggestions of Richard Roll, Robert Faff, John Powell, Liliana Gonzlez, Zelda Jordan, Vince Hooper, Mohammad Tahir and seminar participants at the Doctorate Seminar of European Financial Management Meeting 1999 on this chapter. Special thanks to Adrian Pagan for his constructive comments on research techniques. This chapter has benefited significantly from Adrian's suggestions.

relationship between the measures and document a strong lead in underpricing, such that underpricing leads the number of IPO issues by around six months.

6.2 Data

A sample of 6,632 IPOs is drawn from all new (listed) equity issues made in the USA during the period of January 1976 to June 1998.[67] The cyclical behaviour of the aggregate US IPO market is examined using the four previously described measures of IPO activity.[68] These measures capture both volume and underpricing aspects of the market. Recall that the measures are a proportionate indicator of the number of IPOs (NOIPO), gross proceeds measuring total size of the new issues (GP), a value-weighted underpricing measure (VWUP) and a measure of the value of underpricing (VUP). The summary statistics for these measures have been discussed in detail earlier in Chapter five.

6.3 Research Method

A cycle is traditionally defined in term of the peaks and troughs in the level of variables that measure economic activity (Burns and Mitchell 1946). In the classic way, the analysis of cycles involves the location of turning points by inspecting and interpreting graphs of aggregate data. The location of turning points can be identified through a visual analysis (e.g. Burns and Mitchell 1946; Adelman and Adelman 1959) or a dating algorithm, such as a pattern recognition technique with a sequence of rules. Perhaps, the best-known dating algorithm was developed by Bry and Boschan

[67] Refer to Chapter four for details.
[68] Refer to Chapter five for details.

(1971). The general approach involves several steps looking for turning points in a smoothed series. The final points are determined using an unsmoothed series and verifying that the turns satisfy a set of rules.

More recently, research into cycles has moved towards quantitative measures involving parametric models (e.g. Hamilton 1989; Layton 1996). A recent technique is the Markov regime switching method proposed by Hamilton (1989). Hamilton applies this technique to US GNP data and the results are generally consistent with those published by the National Bureau of Economic Research (NBER). Regime-switching models have also been used extensively in modelling the nonlinear structure of financial time series (e.g. Schaller and Van Norden 1997; Assoe 1998).

In this chapter, our aim is to confirm the existence of cycles in the aggregate US IPO market. A number of steps are used to determine turning points in IPO activity. First, visual analysis to isolate turning points is conducted by incorporating the criteria used by the NBER. The advantage of locating the turning points in this way is to gain an understanding of the general behaviour of the series and avoid false turning points (i.e. if a cycle is short lived or of insufficient amplitude). Second, the visual judgments are then tested using a dating algorithm developed by Bry and Boschan (1971). The advantage of the Bry and Boschan method is that it is easily implemented and can be readily replicated (King and Plosser 1994). Finally, the Markov regime switching technique is fitted.

6.3.1 *Visual Analysis*

The approach used to visually analyse the turning points in IPO activity follows that used by the NBER. The NBER is traditionally considered to be the most accurate source of business cycle chronology in the USA. An NBER Business Cycle Dating Committee dates the cycles for the US economy. Burns and Mitchell (1946) provide a brief description of the approach explaining how NBER locate turning points in economic series.[69] The main criteria are that a phase must last at least six months and a complete cycle should have a minimum duration of fifteen months.[70]

The first step of the NBER analysis is to determine which of the fluctuations in the series should be recognized as cyclical. After a number of cycles have been detected, identification of peaks and troughs is conducted and five selection rules are followed:

1) Peaks and troughs are marked at the highest and lowest points of the specific cycles
2) In the case of equal values, the last point is selected as the turning point
3) A peak (trough) cannot be followed by another peak (trough) without the observance of a trough (peak)
4) A phase has a minimum duration of six months and a whole cycle has a minimum duration of 15 months
5) Points that are too close to the beginning or end of the series (less than 6 months) are eliminated.

[69] This traditional approach by the NBER on dating business cycle is still continuing today. Generally, the turning dates of the business cycle are announced with a lag of up to 20 months to ensure that these dates are as accurate as possible.

[70] By definition, a peak phase is the transition from the end of an expansion to the start of a contraction and a trough phase occurs at the bottom of a recession just as the economy enters a recovery (Burns and Mitchell 1946). Therefore, a complete business cycle experiences periods of a peak phase and a trough phase.

When turning points are identified, the points are marked with the corresponding date and reported.

6.3.2 The Bry and Boschan Method

The NBER dating method is subject to several limitations. For instance, it has been critised for lacking a statistical foundation (e.g. Stock and Watson 1998). Also, implementation depends on individual judgments. Importantly, the process requires detailed prior knowledge of economic conditions to form a judgment of turning points in the business cycle (King and Plosser 1994).

Bry and Boschan (1971) overcome the problem of the traditional NBER method by developing an algorithm for business cycle analysis. The advantage of the Bry and Boschan method is that it can be easily implemented and readily replicated without the requirement of prior knowledge of economic conditions (King and Plosser 1994). Since the introduction of the Bry and Boschan method, it has been used widely in business cycle analysis (e.g. King and Plosser 1994; Simkins 1994; Harding and Pagan 1999b). Using US real GNP data, King and Plosser (1994) show that the turning points selected by the Bry and Boschan (1971) algorithm are consistent with the business cycle peaks and troughs selected by the traditional NBER method.[71] The Bry and Boschan procedure for selecting turning points in any series is described below:[72]

1. Determination of extremes and substitution of values
2. Determination of cycles in 12-month moving averages (extremes replaced)

[71] For 51 indicator series examined, the Bry and Boschan method selected 94% of the turns published by the NBER.
[72] This is taken from Bry and Boschan (1971, p. 21).

(2a) Identification of points higher (or lower) than 5 months on either side

(2b) Enforcement of alternation of turns by selecting highest of multiple peaks (or lowest of multiple troughs)

3. Determination of corresponding turns in Spence curve (extremes replaced)

(3a) Identification of highest (or lowest) value within ± 5 months of selected turn in 12-month moving average

(3b) Enforcement of minimum cycle duration of 15 months by eliminating lower peaks and higher troughs of short cycles

4. Determination of corresponding turns in short-term moving average of 3 to 6 months depending on MCD (months of cyclical dominance)

(4a) Identification of highest (or lowest) values within ± 5 months of selected turn in Spence curve

5. Determination of turning points in the unsmoothed series

(5a) Identification of highest (or lowest) value within ± 4 months, or MCD term, whichever is larger, of selected turn in short-term moving average

(5b) Elimination of turns within 6 months of beginning and end of series

(5c) Elimination of peaks (or troughs) at both ends of series which are lower (or higher) than values closer to end

(5d) Elimination of cycles whose duration is less than 15 months

(5e) Elimination of phases whose duration is less than 5 months

6. Statement of final turning points.

6.3.3 *Markov Regime Switching Method*

The existence of hot and cold periods in the market implies a series of structural breaks in the data. Traditional statistical analysis for structural change includes the Chow test, Cumulated Sum of Residuals (CUSUM) and CUSUM of Squares of Residuals (CUSUMSQ) tests. The Chow test requires prior knowledge (or at least a guess) of break points. If structural breaks cannot be identified ex-ante, then the strength of the Chow test diminishes considerably (Gujarati 1995). Such a test is inappropriate in our analysis since we have no theoretical basis on which to form prior knowledge.

CUSUM and CUSUMSQ tests are appropriate for time-series data. However these tests are also limited, as they cannot clearly identify turning points of structural change. The recursive nature of the tests requires time to recognise a regime shift once it has occurred (Greene 1993), especially when the shifts are large (Montgomery 1991).

Instead, we focus on the technique developed by Hamilton (1989). This technique is a Markov-based regime-switching model for modelling time series subject to non-linear regime changes. In an application of the model, Hamilton reports estimated parameters that reproduce the characteristics of the business cycle through a two-state version applied to quarterly US GNP data.

The concept behind regime-switching is to allow the parameters of a time-series process to take on different values which are dependent on the latent regime indicator (denoted as S_t). The unobservable regime indicator takes on different states, although applications generally restrict it to just two states. The data are used to estimate the parameters in each state as well as the probability that the underlying process is in a particular state. The parameters are viewed as the outcomes of a discrete-state Markov process. An important practical advantage of the regime-switching model is its ability to quickly identify regime shifts, using all the data up to a specific month to form a judgment. The model can be used in the absence of perfect knowledge of historical regime shifts (Layton 1996).

More recently, regime-switching models have been used extensively in modelling nonlinear structures in time series data. The advantage of this approach is that it defines in an objective manner the hot and cold periods. Such identification is potentially useful in any further examination of the impact of other variables on the market. Schaller and Van Norden (1997) use the technique and find strong evidence of regime switching in US stock market returns. Assoe (1998) shows strong evidence of regime-switching behaviour in emerging stock market returns. Hamilton and Lin (1996) use the model to capture the nonlinear dynamics in the stock market and business cycle. Gray (1996) develops a regime-switching model with time-varying properties and applies it to interest rates. In this study, we also use Hamilton's approach to examine and date hot issue cycles in the IPO market.

In the current context, the level of IPO activity may be subject to occasional and discrete shifts over time such that different regimes are observed. We call these regimes the 'hot' and 'cold issue' periods.

Regime switching in the IPO market could arise in several ways. First, changes in economic conditions may induce regime switches. For instance, Allen and Faulhaber (1989) suggest that the hot issue market in 1980 was associated with the 1979 oil crisis. More generally, it appears logical to assume that changes in economic growth affect growth in the corporate sector and consequentially the propensity for firms to seek new equity from the market. Second, changes in investor sentiment may induce regime switches. Rajan and Servaes (1995) argue that an increase in investor sentiment may increase the number of new issues. Further, mutual fund net cash flows have been used as a measure of investor sentiment (Neal and Wheatley 1998; Keim and Stambaugh 1986). Ritter (1998) suggests that hot issue markets might be related to increases in mutual fund net cash flows. Increases in net cash flows increase the demand for securities generally, but specifically IPOs as they represent a perceived extension of the investment set. Third, regime switches could be related to changes in stock market conditions. Loughran et al. (1994) and Rees (1997) provide evidence of a positive relationship between stock market conditions and IPO activity. It is argued that issuers consider stock market conditions when timing their issues.

In the context of IPO markets, two regimes can be identified, a hot period (state 0) and a cold period (state 1). Therefore, the regime indicator, S_t, takes on the value of 1 when the IPO market is in cold periods and 0 when the IPO market is in hot periods. The probability that state 0 (1) will persist from one period to the next is given as *q (p)*. The probability of moving from state 0 to state 1 is *1-q*, and moving from state 1 to state 0 is *1-p*, so the regime is assumed to be unknown and is also independent across time. For each regime, the probability rule to govern the likelihood of various observations is the normal density function, with different means (a_{01} and a_{02}) and standard deviations (σ_1 and σ_2). Hence, in hot periods, IPO activity measures are drawn from a distribution with a mean a_{01} and standard deviation, while in cold periods, IPO activity measures are drawn from a distribution with a mean a_{02} and standard deviation σ_2 . Thus, each regime is characterized by a different mean and standard deviation.

Formally, let Y_t denote any measure of IPO activity, then:

$$Y_t = a_{01}(1-S_t) + a_{02}S_t + [\sigma_1(1-S_t) + \sigma_2 S_t]\varepsilon_t \qquad (1)$$

where

S_t is a binary state variable that follows a first-order Markov Chain such that:

$\Pr(S_t = 0 | S_{t-1} = 0) = q$

$\Pr(S_t = 1 | S_{t-1} = 0) = 1 - q$

$\Pr(S_t = 1 | S_{t-1} = 1) = p$

$\Pr(S_t = 0 | S_{t-1} = 1) = 1 - p$

and $\varepsilon_t \sim N(0, \sigma^2)$.

To obtain estimates of the parameter vector (a_{01}, a_{02}, σ_1 and σ_2), maximum likelihood estimation is used (Hamilton 1989). The maximum likelihood estimate of the two transition probabilities (1-q and 1-p) is the fraction of time that the system is in one state before moving to another state. In other words, the estimated transition probability, 1-q, is the number of times state 0 is followed by state 1 divided by the number of times the process is in state 0. The benefit of using the above process in modeling regime switching in the IPO activity is that it allows investors to generate meaningful forecasts that take into account the possibility of the change from one regime to another. Furthermore, the transition probabilities obtained help to assess the duration of each regime. For instance, the expected duration of hot issue cycles can be obtained by calculating $(1\text{-q})^{-1}$ and, conversely, for cold issue cycles the duration is calculated as $(1\text{-p})^{-1}$.

If peaks and troughs selected by the Bry and Boschan method fall into the hot and cold issue periods identified by the Markov regime switching technique, our dating results can be confirmed.

Of note, the Bry and Boschan method determines peak and trough points in the series while our Markov regime switching method identifies hot and cold periods in the series. This is a major difference between the Bry and Boschan method and the Markov regime switching technique. The ability to identify certain cyclical periods in the series rather than the points of peak and trough is an advantage of the Markov regime switching technique. Further, the identification of periods rather than points leads to more relevant analysis of the impact of adverse market conditions on IPO activity.[73]

6.4 Empirical Results

6.4.1 Visual Analysis

The turning points in the series identified through visual analysis are labeled with corresponding dates and are presented in Figures 6.1 to 6.4. The cyclical patterns in the series of NOIPO, GP and VUP are relatively clear. The determination of turning points for VWUP, however, is more troublesome. The pattern of VWUP is quite volatile, especially in the 1990s. Since we do not have detailed prior knowledge of market conditions for the period, the judgement is made based on selection rules and careful reading.

In Figure 6.1, the pattern for NOIPO before May 1985 is almost flat with minor fluctuations. As a result, it is difficult to locate a turning point for the period. A trough was originally located in April 1997 followed by a peak in November 1997 (see * symbols). However, our selection rules require a minimum duration of six months for a phase. Therefore, this possible point is ignored.

[73] However, the method has been criticized for its statistical properties. For instance, Harding and Pagan (1999b) find little evidence concerning the importance of non-linear features in analysis of economic cycles.

Figure 6.1: Visually Identified Turning Points for NOIPO in the USA

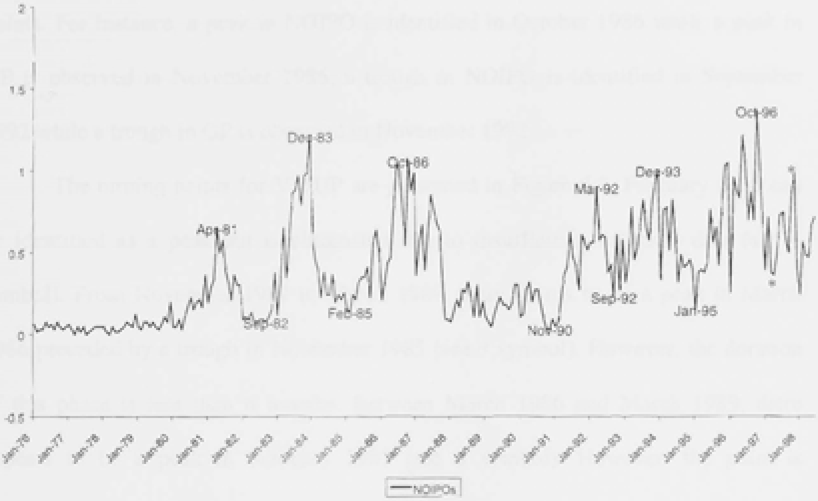


Figure 6.2: Visually Identified Turning Points for GP in the USA

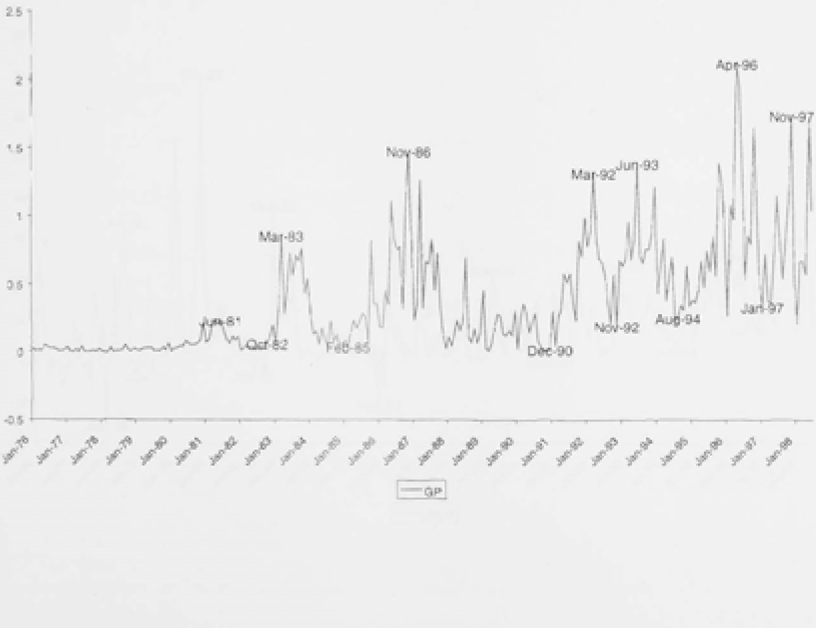


Figure 6.2 reports turning points for GP based on visual analysis. The pattern for GP is quite similar to that of NOIPO though there are slight variations in turning points. For instance, a peak in NOIPO is identified in October 1986 while a peak in GP is observed in November 1986, a trough in NOIPO is identified in September 1992 while a trough in GP is observed in November 1992.

The turning points for VWUP are presented in Figure 6.3. February 1976 can be identified as a peak but is eliminated due to insufficient historical data (see + symbol). From November 1982 to March 1989, there seems to be a peak in March 1986 preceded by a trough in November 1985 (see * symbol). However, the duration of this phase is less than 6 months. Between March 1986 and March 1989, there appears to be a peak in February 1987 (see # symbol). However, the point is eliminated since the value for VWUP in February 1987 is less than the value of VWUP in March 1986.

Figure 6.3: Visually Identified Turning Points for VWUP in the USA

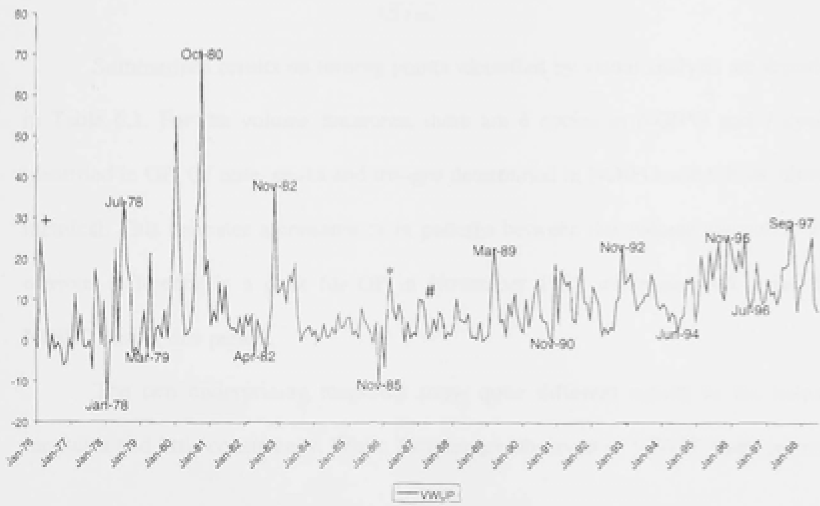


Figure 6.4 reports turning points for VUP. It reveals that VUP is more stable than its underpricing counterpart, VWUP. Before 1995, the pattern in VUP is almost flat and the turning points identified in the period appear to have smaller magnitudes compared with those of VWUP in the period. An extreme peak point is observed in May 1996. This is due to a number of large issues during the period though associated underpricing is not extremely high.[74]

Figure 6.4: Visually Identified Turning Points for VUP in the USA

Summarised results on turning points identified by visual analysis are reported in Table 6.1. For the volume measures, there are 6 cycles in NOIPO and 7 cycles identified in GP. Of note, peaks and troughs determined in NOIPO and GP are almost identical. This indicates a consistency in patterns between the volume measures. The obvious difference is a peak for GP in November 1997 while no peak exists for NOIPO during this period.

The two underpricing measures show quite different results to the volume measures and little consistency. While 7 cycles are observed in VWUP, there are only

[74] For instance, Saks Holdings experienced underpricing of 39% with total proceeds of US$275 million and Associates First Capital experienced underpricing of 20% with total proceeds of US$1.7 billion.

5 cycles observed in VUP. Moreover, the dates observed in the underpricing measures are somewhat different to the dates in the volume measures. Of note, both underpricing measures exhibit a hot issue market at the end of 1980 though the peak point of December 1980 in VUP is two months later than in VWUP and is of smaller magnitude. This finding of a peak in 1980 is consistent with the finding of Ritter (1984b).

Table 6.1: Turning Points of the US IPO Activity Based on Visual Analysis

	Peak	Trough
Number of IPOs (NOIPO)		
	Apr 81	Sep 82
	Dec 83	Feb 85
	Oct 86	Nov 90
	Mar 92	Sep 92
	Dec 93	Jan 95
	Oct 96	
Gross Proceeds (GP)		
	Jun 81	Oct 82
	Mar 83	Feb 85
	Nov 86	Dec 90
	Mar 92	Nov 92
	Jun 93	Aug 94
	Apr 96	Jan 97
	Nov 97	
Value-Weighted IPO Underpricing (VWUP)		
		Jan 78
	Jan 78	Mar 79
	Oct 80	Apr 82
	Nov 82	Nov 85
	Mar 89	Nov 90
	Nov 92	Jun 94
	Nov 95	Jul 96
	Sep 97	
Value of Underpricing (VUP)		
	Dec 80	Oct 82
	Jun 83	Nov 85
	Mar 87	Nov 88
	Jun 93	Aug 94
	May 97	

6.4.2 The Bry and Boschan Method

Table 6.2 summarises the turning points selected by the algorithm of the Bry and Boschan method. As can be seen from the table, the two volume measures, NOIPO and GP, exhibit similar turning dates to each other. Both series show the existence of seven cycles over the sample period and the dates of the peaks coincide with slight deviations up to two months, except for the year 1993. The finding of similarity in the turning dates between the volume measures is consistent with the earlier results based on visual analysis.

In contrast, the two underpricing measures give different results to each other. Although both series exhibit five cycles, the dates of the peaks are somewhat different, except for October 1980 and May 1996. The dates of the peaks in VUP display some consistency with those dates identified in the two volume measures and the peaks in VUP appear to lead the peaks in the two volume measures. For instance, a peak in VUP in October 1980 is followed by a peak in NOIPO in April 1981, a peak in VUP in June 1983 is followed by a peak in NOIPO in December 1983, and a peak in June 1986 in VWUP and is followed by a peak in NOIPO in October 1986. Hence, it appears that VUP leads NOIPO by several months. This implies a potential lead and lag relationship between the underpricing and volume measures.

Compared with the results of visual analysis, the peaks and troughs identified are reasonably consistent, but there are some anomalies. For instance, a peak for NOIPO in April 1990 identified by the Bry and Boschan method is not picked up in the visual analysis. This appears to be related to high volatility around this period. Also, visual analysis determines a peak for VWUP in March 1989 but the Bry and Boschan method does not. This might be due to the detrending process used in the Bry and Boschan process which smooths the magnitude of this point.

Table 6.2: Turning Points of the US IPO Activity Using the Bry and Boschan Method

	Peak	Trough
Number of IPOs (NOIPO)		
		Mar 78
	Apr 81	May 82
	Dec 83	Feb 85
	Oct 86	Mar 89
	Apr 90	Oct 90
	Mar 92	Sep 92
	Dec 93	Jan 95
	May 96	
Gross Proceeds (GP)		
		Jul 77
	Apr 81	Jun 82
	Oct 83	Feb 85
	Nov 86	Mar 89
	Mar 90	Nov 90
	Mar 92	Nov 92
	June 93	Jul 94
	Apr 96	Jan 97
Value-Weighted IPO Underpricing (VWUP)		
	Jul 78	Mar 79
	Oct 80	Apr 82
	Nov 82	Feb 84
	Jan 85	Apr 92
	Nov 92	June 94
	May 96	
Value of Underpricing (VUP)		
	Oct 80	Aug 82
	Jun 83	Feb 84
	Jun 86	Nov 88
	Jun 93	Jul 94
	May 96	Apr 97

6.4.3 Evidence of Structural Breaks in Measures of IPO Activity

Before we fit a Markov regime switching method into the data, CUSUM and CUSUMSQ tests are first conducted on the four IPO activity measures to ascertain the existence of structural breaks in each series. Figures 6.5 to 6.8 show the CUSUM and CUSUMSQ tests. The results of these tests provide strong evidence that structural breaks exist in all series. For instance, Figure 6.5a shows that the CUSUM for NOIPO strays outside the boundary from June 1983, which suggests that the parameters are not constant across the period. The CUSUMSQ result for NOIPO reported in Figure 6.5b also casts doubt on the parameter stability as the parameters stray outside the confidence bounds on several occasions.

In summary, the CUSUM and CUSUMSQ tests provide evidence of the existence of structural breaks in all four series. However, as mentioned previously, the CUSUM and CUSUMSQ tests cannot clearly determine the switching points between regimes.

Figure 6.5a: CUSUM Test for NOIPO in the USA

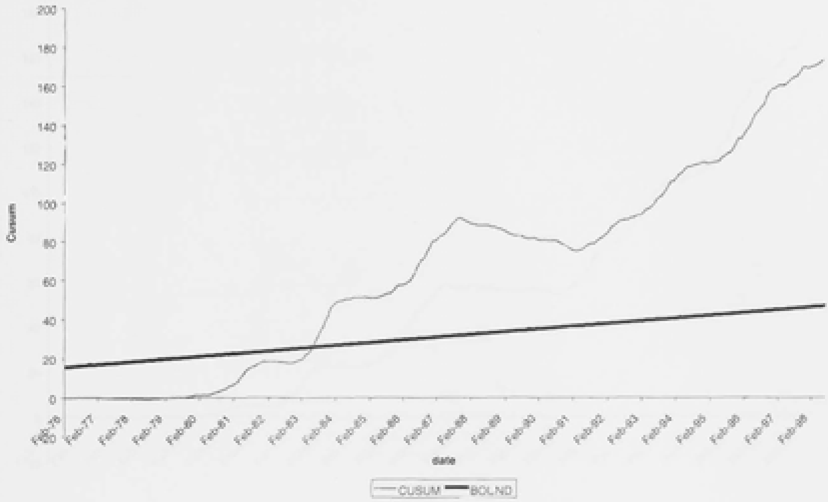


Figure 6.5b: CUSUMSQ Test for NOIPO in the USA

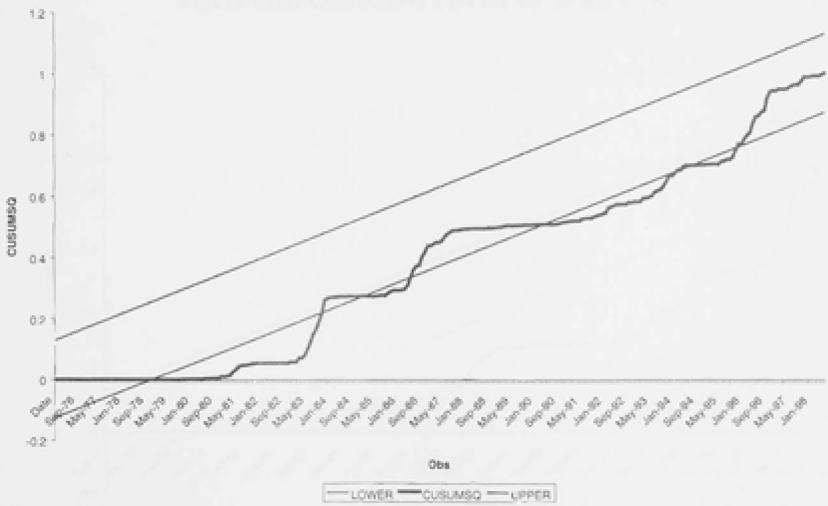


Figure 6.6a: CUSUM Test for GP in the USA

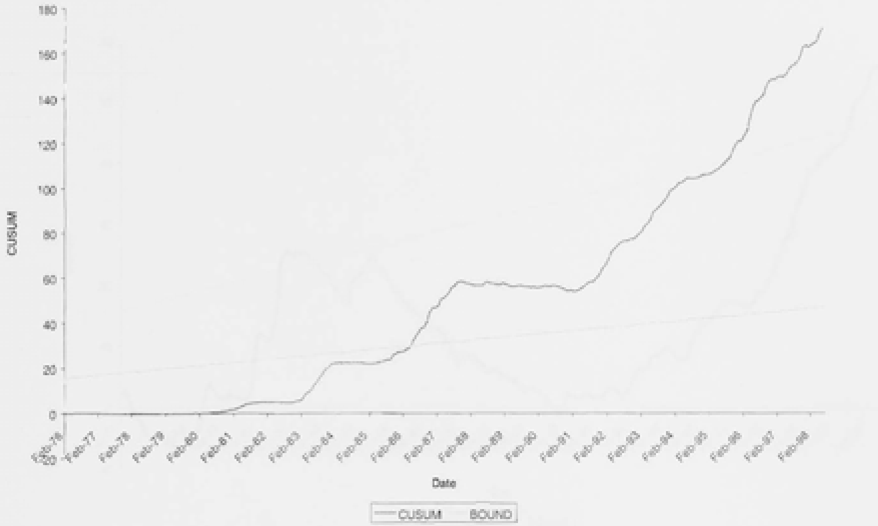


Figure 6.6b: CUSUMSQ Test for GP in the USA

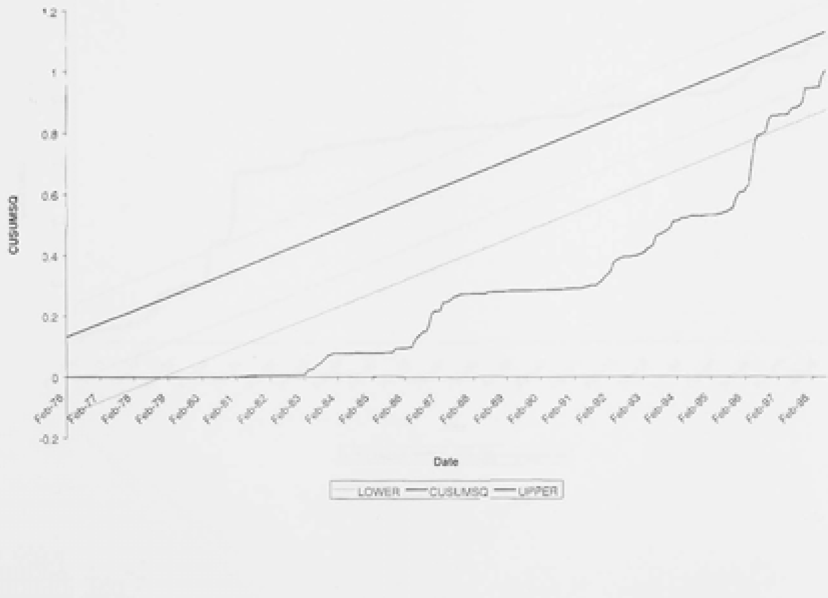


Figure 6.7a: CUSUM Test for VWUP in the USA

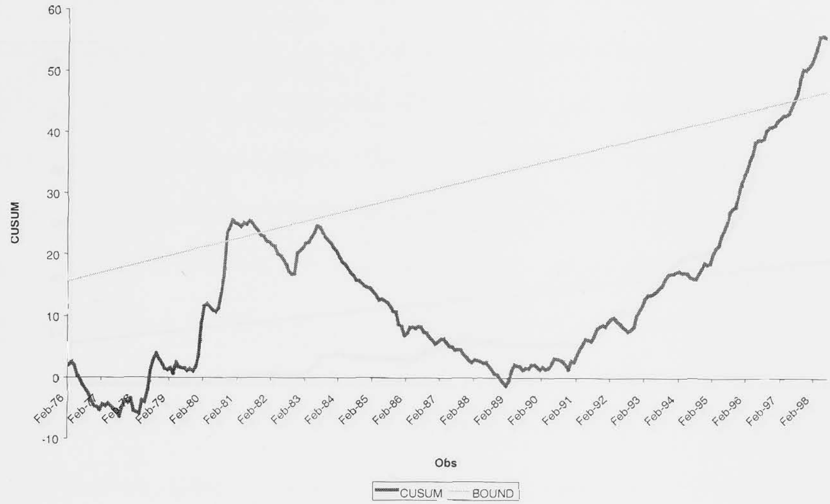


Figure 6.7b: CUSUMSQ Test for VWUP in the USA

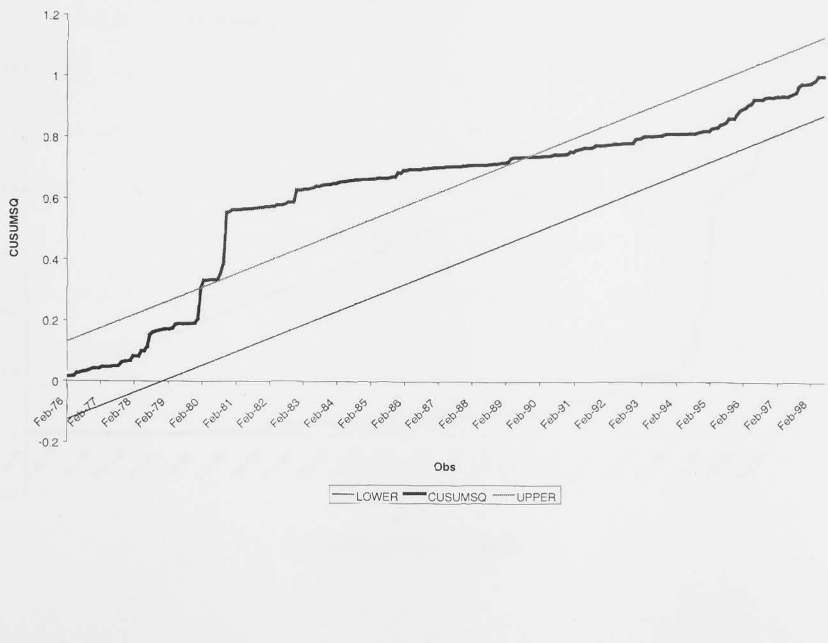


Figure 6.8a: CUSUM Test for VUP in the USA

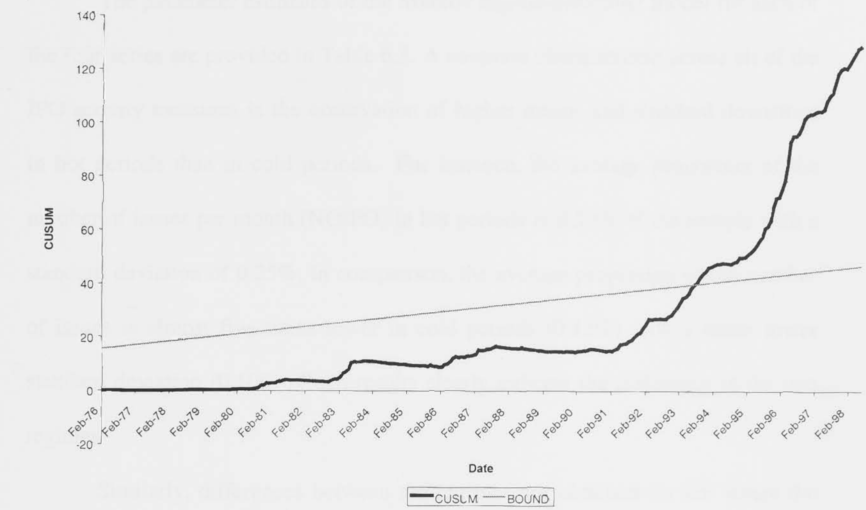
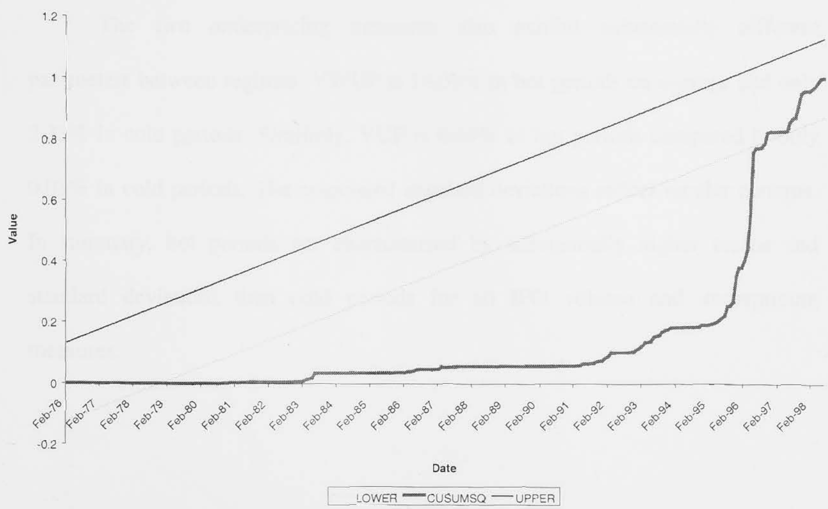


Figure 6.8b: CUSUMSQ Test for VUP in the USA



6.4.4 Markov Regime Switching Method

The parameter estimates of the Markov regime-switching model for each of the four series are provided in Table 6.3. A common characteristic across all of the IPO activity measures is the observation of higher means and standard deviations in hot periods than in cold periods. For instance, the average proportion of the number of issues per month (NOIPO) in hot periods is 0.59% of the sample with a standard deviation of 0.25%. In comparison, the average proportion of the number of issues is almost five times lower in cold periods (0.13%) with a much lower standard deviation (0.10%). Such results clearly indicate the difference in the two regimes.

Similarly, differences between the regimes are obtained for GP where the average proportion of gross proceeds per month in hot periods is 0.69% of the sample compared to only 0.09% in cold periods. Again, the standard deviation is much higher in hot periods than cold periods (0.37% vs. 0.09%).

The two underpricing measures also exhibit substantially different parameters between regimes. VWUP is 14.09% in hot periods on average and only 3.33% in cold periods. Similarly, VUP is 0.69% in hot periods compared to only 0.03% in cold periods. The associated standard deviations reflect similar patterns. In summary, hot periods are characterised by substantially higher means and standard deviations than cold periods for all IPO volume and underpricing measures.

Table 6.3: Maximum Likelihood Estimates from the Markov Regime Switching Model on the US IPO Activity Measures

$$Y_t = a_{01}(1-S_t) + a_{02}S_t + [\sigma_1(1-S_t) + \sigma_2 S_t]\varepsilon_t$$

where S_t denotes the state of the world for hot ($S_t = 0$) and cold ($S_t = 1$) markets

	NOIPO		GP		VWUP		VUP	
Parameter	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1-q	0.0219*	0.0099	0.0290	0.0161	0.1032*	0.0335	0.0407*	0.0157
1-p	0.0319*	0.0149	0.0325*	0.0160	0.1052*	0.0318	0.0509*	0.0202
a_{01}	0.5929*	0.0235	0.6927*	0.0332	14.0887*	1.1992	0.6912*	0.0619
a_{02}	0.1274*	0.0109	0.0879*	0.0082	3.3250*	0.4329	0.0301*	0.0035
σ_1	0.2457*	0.0135	0.3730*	0.0230	10.2330*	0.7070	0.7101*	0.0441
σ_2	0.0956*	0.0077	0.0897*	0.0068	3.7170*	0.4272	0.0380*	0.0029

* denotes significance at 5%

The estimated regime probabilities for each data point are reported in Figures 6.9 to 6.12. These probabilities are used to determine the timing of regime shifts in each of the activity measures. A problem with the probability plots is determining the state when the probabilities are distant from either zero or unity. In the absence of any prior information, we set the transition level rule at a probability of 50%. Hence an observation is determined to be in a state (S_t) if the probability of being in that state exceeds 0.5.

A further issue arises, as the switching model can be quite sensitive and at times provides transition reversals across consecutive months.[75] To overcome this problem, we define a state as one where at least six consecutive probabilities are greater than 0.5. The rationale is that hot periods are likely to be driven by fundamental shifts in economic factors or investor sentiment. Such shifts are likely to have a temporal effect of greater than one month. Moreover, institutional and regulatory features induce lags between the corporate manager's decision to issue and the listing date. These lags have been estimated to be somewhere between three to six months (Lipman 1997). Given that market conditions are likely to influence the manager's decision, temporal swings of one month are not especially relevant and hence we argue that six consecutive months is more realistic with market practice.[76] A similar widely-accepted 'six month' rule is used by the National Bureau of Economic Research (NBER) to determine the minimum length of a phase of the business cycle.

[75] Note that this is a similar rule to the NBER and Bry and Boschan rules designed to avoid false turning points.

[76] Alternative state definitions were employed including consecutive probabilities of greater than 0.5 for at least three consecutive observations and generally the conclusions remain unchanged.

Figure 6.9: Regime Probability of Being in Hot Periods using NOIPO in the USA

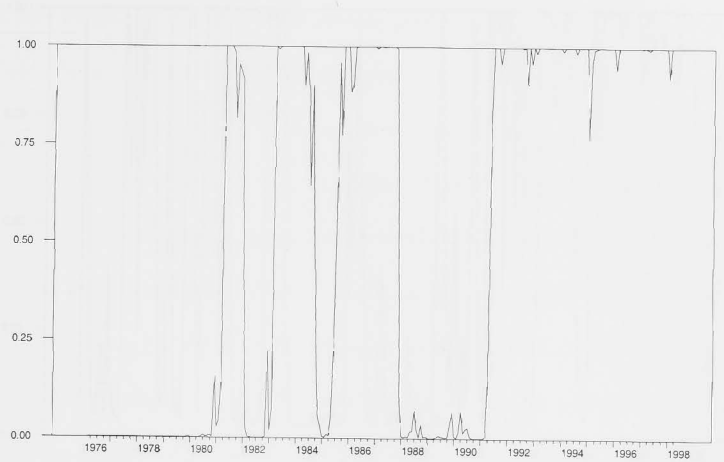


Figure 6.10: Regime Probability of Being in Hot Periods using GP in the USA

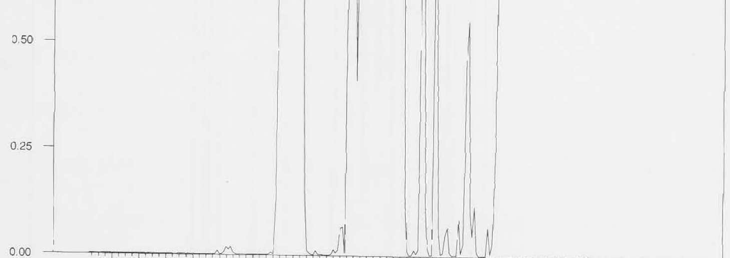


Figure 6.11: Regime Probability of Being in Hot Periods using VWUP in the USA

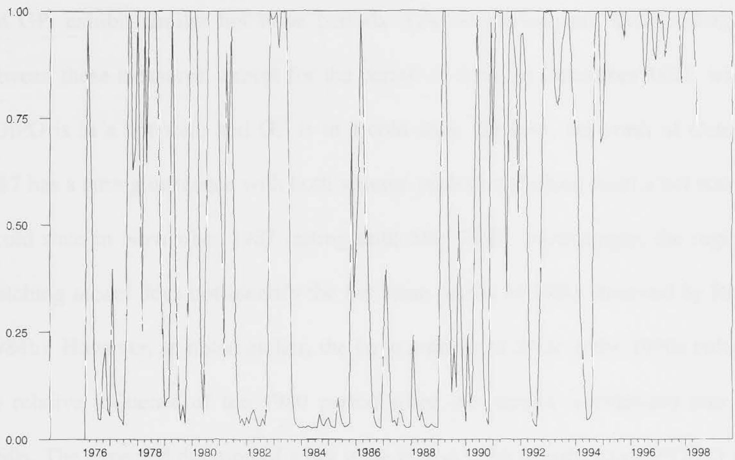
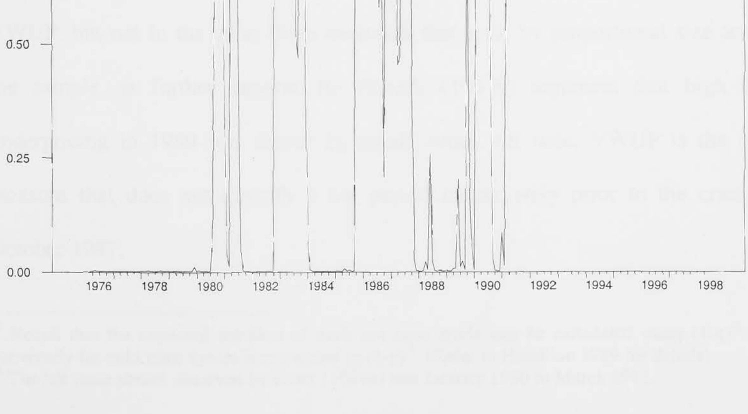


Figure 6.12: Regime Probability of Being in Hot Periods using VUP in the USA



Using the regime probabilities and transition rules, hot and cold issue periods are identified and reported in Table 6.4. The two volume measures, NOIPO and GP, exhibit similar hot issue periods. The hot periods are almost identical between these measures, except for the period of April to December 1981, where NOIPO is in a hot state and GP is in a cold state. Of note, the crash of October 1987 has a strong influence with both volume measures shifting from a hot state to a cold state in November 1987 lasting until May 1991. Interestingly, the regime-switching model does not identify the hot issue period of 1980 observed by Ritter (1984b). However, as noted earlier, the large number of IPOs in the 1990s reduces the relative influence of the 1980 period when the sample is extended into the 1990s. The expected duration of a hot issue period is 46 months using NOIPO and 35 months using GP.[77]

In contrast, the two underpricing measures give different signals. VWUP provides a greater frequency of transition wherein hot periods appear more volatile and less persistent compared to VUP. The expected duration of a hot period using VWUP is only 10 months compared to 24 months using VUP. The hot period identified by VWUP for August 1980 to July 1981 is consistent with the hot issue period observed by Ritter (1984b).[78] The finding of a hot state in this period using VWUP, but not in the other three measures that scale by proportional size across the sample, is further support for Ritter's (1984b) argument that high IPO underpricing in 1980 was driven by small issues. Of note, VWUP is the only measure that does not identify a hot period immediately prior to the crash of October 1987.

[77] Recall that the expected duration of each hot issue cycle can be calculated using $(1\text{-}q)^{-1}$ and conversely for cold issue cycles is calculated as $(1\text{-}p)^{-1}$. (Refer to Hamilton 1989 for details)
[78] The hot issue period observed by Ritter (1984b) was January 1980 to March 1981.

Table 6.4: Chronology of US IPO Activity Based on Transition Probabilities From the Regime-Switching Model January 1976 to June 1998

	Hot Periods	Cold Periods
Number of IPOs (NOIPO)		
		Jan 76 – Mar 81
	Apr 81 – Dec 81	Jan 82 – Feb 83
	Mar 83 – Sep 84	Oct 84 – Jun 85
	Jul 85 – Nov 87	Dec 87 – Apr 91
	May 91 – Jun 98	
Gross Proceeds (GP)		
		Jan 76 – Feb 83
	Mar 83 – Feb 84	Mar 84 – Sep 85
	Oct 85 – Nov 87	Dec 87 – Apr 91
	May 91 – Jun 98	
Value-Weighted IPO Underpricing (VWUP)		
		Jan 76 – Aug 77
	Sep 77 – Oct 78	Nov 78 – Jul 80
	Aug 80 – Jul 81	Aug 81 – Oct 82
	Nov 82 – Jul 83	Aug 83 – Nov 90
	Dec 90 – Mar 92	Apr 92 – Oct 92
	Nov 92 – Jun 98	
Value of Underpricing (VUP)		
		Jan 76 – Oct 82
	Nov 82 – Dec 83	Jan 84 – Sep 85
	Oct 85 – Sep 87	Oct 87 – Jan 90
	Feb 90 – Jul 90	Aug 90 – Feb 91
	Mar 91 – Jun 98	

In comparison, VUP identifies a hot period between October 1985 and September 1987 ending one month before the crash. Of note, the hot period in the volume measures persisted until November 1987. This difference may be explained due to the difficulty in recalling an issue once it has commenced. Hence, the volume measures are not as dynamic in their response to changes in market conditions as price based measures such as VUP. The persistence in the volume measures during adverse market conditions supports the argument that even if issuers respond to market conditions when making timing decisions, the lag induced by institutional and regulatory requirements exposes issuers to the risk of making an issue during market downturns.

The most common hot issue period observed across all measures of IPO activity is May 1991 to June 1998. As with the transition to the cold period associated with the crash of October 1987, there appears to be a strong correlation between IPO activity, business and stock market conditions.[79] For instance, from the early 1990s it is widely recognised that the stock market has been experiencing a sustained bull run with market indicators and price-earnings ratios reaching record highs and dividend-to-price ratios reaching historical lows.[80] Further, NBER reported that the US economy is experiencing a bull run since March 1991. Similarly, all the IPO activity measures indicate a sustained hot issue period from 1991. This period is the longest of all hot periods documented over the sample. Except for this latter hot period, the duration of hot periods is shorter than cold

[79] Of note, Choe et al. (1993) document that the frequency of seasoned offerings also rises in economic upturns using US data from 1971 to 1991. They identify a positive relationship between equity issue volume and economic activity arguing that firms will issue equity when the effects of adverse selection, as a proportion of investment returns, are less important in the presence of improved business conditions.

[80] From 1990 through June 1998, the S&P 500 index increased more than 245% from a level of 329 in January 1990 to 1133 by June 1998 and the price-earnings ratios were more than 28.65 with dividend-to-price ratios at historical lows (less than 2%) in June 1998. Edwards and Zhang (1998) also document some of the statistics concerning market conditions experienced during the 1990s.

periods. This finding is inconsistent with evidence from the business cycle where expansionary swings are longer than contractions (Hamilton 1989; Layton 1996). However, the sample period is too short to make sustained judgments.

Of note, most peaks selected prior to 1990 using both visual analysis and the Bry and Boschan methods fall into the corresponding hot issue periods identified by the Markov regime switching technique. This provides further support for the results. While the whole period of May 1991 to June 1998 is regarded as a common hot issue period in all measures using the Markov regime switching method, the visual analysis and the algorithm of the Bry and Boschan method identify more cycles in all measures during this period. This difference can be explained by the different criteria imposed on the methods. While the regime switching model identifies regime shifts using data up to the specific month to form a judgement, the visual analysis and the Bry and Boschan method limit their selection of a turning point to a period of ± 5 months. Further, a hot or cold period in the regime switching method is defined as one lasting at least six months. Nevertheless, in general, the various methods all provide consistent results.

6.4.5 Explanatory Relationships

The identified periods in Tables 6.2 and 6.4 indicate some lead-lag features between the volume and underpricing measures. Specifically, the hot periods in the underpricing measures appear to lead the hot periods in the volume measures. For instance in Table 6.4, a hot period in VWUP commenced in August 1980 and is followed by a hot period in NOIPO in April 1981, a hot period commenced in VWUP in November 1982 and is followed by a hot period in NOIPO in March

1983, and a hot period commenced in December 1990 in VWUP and is followed by a hot period in NOIPO in May 1991. These are casual observations and we now turn to statistical analysis of the relationships between the measures. In this case, the power of conventional tests (such as OLS based tests) is limited by the nature of the probability distributions, as by definition, the probabilities lie between zero and one. Therefore, Spearman correlation tests are used to estimate the relationship between the estimated probabilities.

Table 6.5 reports the Spearman Rank correlation coefficients between current and lagged estimated regime switching probabilities of NOIPO and VWUP. There is a contemporaneous correlation between the two series. Further, while the estimated probabilities of VWUP show no correlation with lagged probabilities of NOIPO up to 6 months, the probabilities of NOIPO show strong correlation with lagged probabilities of VWUP up to six months. This evidence supports a lead-lag relationship between IPO volume and underpricing. Specifically, underpricing leads IPO volume by up to six months.

This evidence supports the argument that the management decision to issue is a function of current observed underpricing (Rock 1986; Firth 1997). Moreover, IPO issuers cannot respond instantaneously to market conditions due to a three to six month lag during which various activities are undertaken to fulfil the legal requirements and promote the issue (Lipman 1997).[81]

[81] This issue and the relationship between underpricing and volume are explored in detail in Chapter eight.

Table 6.5: Spearman Rank Correlation Coefficients of Estimated Probabilities between NOIPO and VWUP

	NOIPO	NOIPO_1	NOIPO_2	NOIPO_3	NOIPO_4	NOIPO_5	NOIPO_6
VWUP	0.1678*	0.1122	0.0690	0.0338	-0.0079	-0.0299	-0.0473
VWUP_1	0.2346*	0.1660*	0.1104	0.0673	0.0321	-0.0098	-0.0317
VWUP_2	0.2665*	0.2321*	0.1636*	0.1085	0.0655	0.0300	-0.0111
VWUP_3	0.3039*	0.2613*	0.2270*	0.1607*	0.1050	0.0615	0.0290
VWUP_4	0.3536*	0.2989*	0.2564*	0.2243*	0.1575*	0.1010	0.0605
VWUP_5	0.3735*	0.3493*	0.2946*	0.2543*	0.2216*	0.1542*	0.1001
VWUP_6	0.3855*	0.3704*	0.3461*	0.2929*	0.2526*	0.2191*	0.1537*

Notes:
1. * denotes significant at 5%
2. NOIPO_m denotes the lagged terms for NOIPO, where m= 1,2,…,6
3. VWUP_m denotes the lagged terms for VWUP, where m= 1,2,…,6

In summary, while hot periods are characterised initially by a large degree of underpricing followed by unusually high volume of new issues, the periods are not completely homogeneous. The activity measures studied here indicate that different periods can be characterized by differences in the type of issues. While the number of issues and total size of issues in each month are generally correlated, the measures of underpricing yield at times quite different results. Hence we argue that hot issue periods are not homogeneous.

6.5 Conclusion

In this chapter, I have analysed the behavior of the US IPO market. Our aim was to formally document the existence of hot and cold issue periods that have previously been claimed to exist, but prior evidence has been superficial. Moreover, through the development of a series of activity variables, I examined different characteristics of the market focussing on volume and underpricing measures of new issues.

Through the application of different dating techniques, a number of regime switches between hot and cold issue markets have been documented over the period 1976 to 1998. In so doing, previously observed hot periods were highlighted and explanations offered as to their existence (e.g. Ritter's 1980 hot market). Hot periods can be described by both volume and underpricing measures although the characteristics of hot periods vary. Hot periods appear related to general stock market conditions, which supports the hypothesis that managers time their issues in an attempt to take advantage of favorable market conditions. However, this timing comes at a risk as the volume measures are relatively slow to respond to downturns in the market. Importantly, a lead-lag relationship is identified, such that underpricing measures lead volume by up to six months. These results provide insights into the IPO market, not previously documented. The following analysis involves a closer examination of the factors associated with the hot and cold periods. However, this task is now possible given the identification of hot and cold periods provided in this chapter.

CHAPTER SEVEN[82]

HOT AND COLD IPO MARKETS: AUSTRALIAN EVIDENCE

7.1 Introduction

The aggregate US IPO market was examined in the previous chapter and the results confirm the existence of hot and cold issue periods in the USA. In this chapter, we focus on the aggregate IPO market in Australia.

The chapter's aim is to examine the existence of hot and cold markets in Australia using a long time-series and to analyse the relationships between various indicator variables. A time series of Australian IPO issues from 1976 to June 1997 is constructed for analysis. Four measures of IPO activity that capture both volume and underpricing aspects of the market are developed and examined. Given arguments concerning the potential differential behaviour and nature of the resource sector, the analysis involves separate considerations of the industrial and resource sectors of the market.[83] In brief, the results support the existence of hot issue periods across all measures of IPO activity. These measures capture different characteristics of the IPO market and we document that hot issue periods can be differentiated. Further, the relationship between the measures is examined and a

[82] The material in this chapter has been condensed into a paper, titled "The Cyclical Behaviour of the IPO Market in Australia", and has been accepted for publication in the *Accounting Research Journal*. In addition to my supervisors, Tim Brailsford and Richard Heaney, I would like to acknowledge the helpful comments of Liliana Gonzalez, Adrian Pagan and John Powell on earlier versions of the chapter. I also thank Dave Allen and Frank Finn for providing some data and information on the Australian market.

[83] Refer to Chapters four and five for a detailed discussion.

lead in underpricing is revealed, such that underpricing leads the number of IPO issues by around six months which is consistent with the relationship observed in the US IPO market (see Chapter six). We offer explanations for this result that yield insight into the market dynamics. Finally, resource sector IPOs are found to exhibit a substantial influence on the pricing measures of IPO activity and are generally not as dynamic in response to adverse market conditions as their industrial counterparts. This latter result has implications for further work and an understanding of the Australian market.

7.2 Data and Research Method

A sample of 766 IPOs is drawn from all new (listed) equity issues made on the Australian Stock Exchange during the period January 1976 to June 1997.[84] Following the extant literature (see Chapter three), the level of IPO activity is examined through two broad measures being volume and underpricing. Consistent with these measures, four variables are developed that measure IPO activity. While NOIPO and GP concern volume, VWUP and VUP concern underpricing. Each variable is measured on a monthly basis.[85]

As discussed in Chapters four and five, the Australian stock exchange traditionally has contained a relatively large proportion of resource sector stocks compared to other national exchanges. Given the arguments concerning the potential differential behaviour and nature of the resource sector (e.g. How 1996; Ritter 1984b), the analysis of the cyclical behaviour of the Australian IPO market

[84] Refer to Chapter four for a description and sources of Australian IPO data.
[85] Refer to Chapter five for details.

involves separate consideration of the industrial and resource sectors of the market.

A brief comparison of resource and industrial sector IPOs in Australia is presented in Table 7.1. There are a total of 244 new issues in the resource sector over the sample (or 32% of all IPOs). These IPOs have an average offer size of A$19 million compared to A$44 million for industrial sector IPOs. Further, the average offer price for natural resource IPOs in the sample is A$0.41 which is considerably lower than the average offer price of A$1.00 for industrial sector IPOs. In relation to underpricing, resource sector IPOs experience an average level of underpricing of 46.5% compared to 23.3% for their industrial sector counterparts. Hence, resource sector IPOs tend to be smaller, lower priced and experience greater underpricing.

Table 7.1: Comparison of Resource and Industrial Sector IPOs in Australia January 1976 – June 1997

	Resource Sector	Industrial Sector
Number of IPOs	244	522
Average Offer Size (A$ mil.)	19	44
Average Offer Price per IPO	A$0.41	A$1.00
Average Underpricing per IPO	46.46%	23.33%

Support for the variation is provided by Michaely and Shaw (1994) who report that small IPOs experience more underpricing than large IPOs.[86] Jain (1995) suggests that this difference may be explained by the information asymmetry

[86] Further evidence is reported by Ibbotson et al. (1994) and Chalk and Peavy (1987). For instance, Ibbotson et al. (1994) report that for 2,439 US IPOs issued between 1975 and 1984, the average initial return on IPOs with an offer price of less than US$3 is 42.8%, whereas it is only 8.6% for IPOs with an offer price higher than US$3.

surrounding an issue wherein information asymmetry is more apparent for small IPOs than for large IPOs. Therefore, the difference in underpricing between the two sectors may be explained by the information asymmetry where information asymmetry is more apparent for small, high risk IPOs than for large IPOs. The implication is that the valuation of resource sector IPOs is more difficult than their industrial counterparts due to a higher degree of information asymmetry.

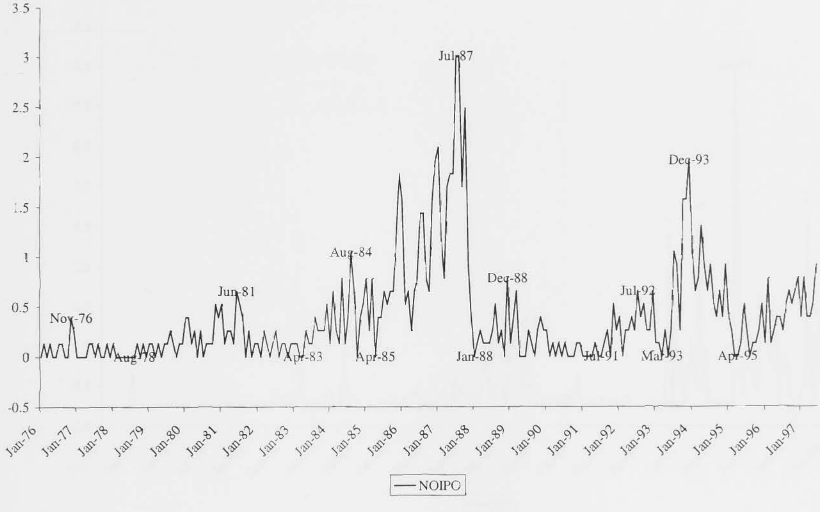
7.3 Empirical Results of Full Sample

Following Chapter six, the research method initially involves a visual analysis, followed by the Bry and Boschan method and then application of a Markov regime-switching model that allows for the identification of the turning points and hot and cold periods in the Australian IPO market. The CUSUM and CUSUMSQ tests are conducted on all Australian IPO series and the results confirm the existence of structural breaks in all series. Although the results of these tests are not reported here, they are available on request.

7.3.1 Visual Analysis

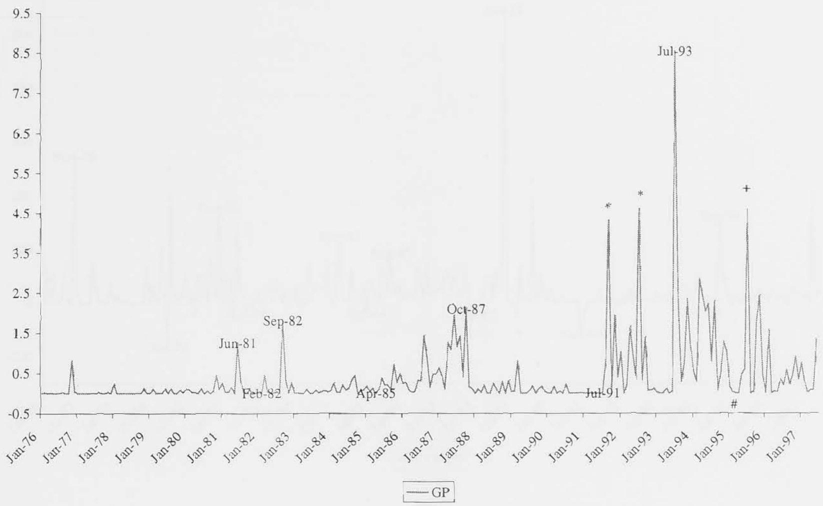
The turning points in the series identified through visual analysis are labeled with corresponding dates and are reported in Figures 7.1 to 7.4. In Figure 7.1, the pattern of NOIPO shows two clear upward cycles in the periods of 1988-1987 and 1993-1995. Between 1988 and March 1993, two peaks may be visually identified (December 1988 and July 1992) though their amplitudes are not as strong as those in 1987 and 1993.

Figure 7.1: Visually Identified Turning Points of NOIPO in Australian IPO Sample



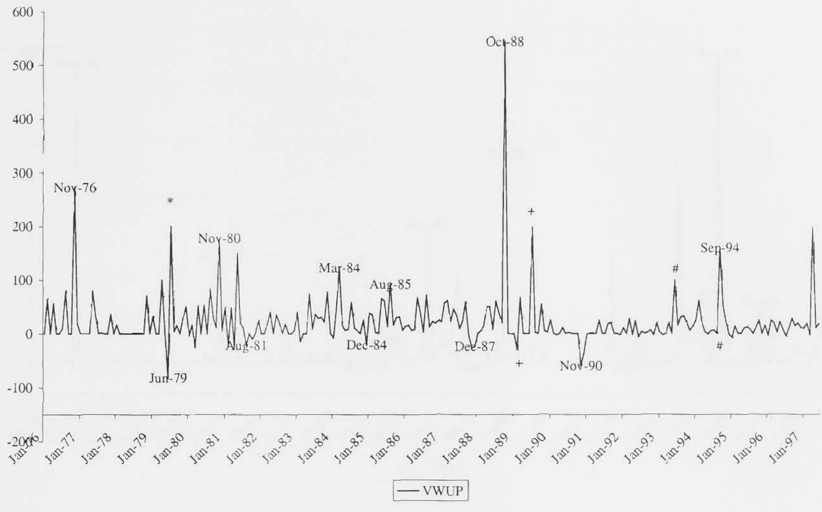
The turning points identified for GP are presented in Figure 7.2. Generally, the pattern of GP is quite flat before July 1991 with relatively minor fluctuations. The pattern becomes more volatile after July 1991 with an extreme peak in July 1993. The months, September 1991 and July 1992, can be identified as two peaks during the period but are eliminated as they fail to meet the criteria of a minimum duration of a cycle lasts for at least 15 months (see * symbols). From April 1995 (see # symbol), there seems to be a peak in July 1995 (see + symbol). However, the duration of this phase is less than six months and is thus also eliminated. Most upward movements appear to be volatile and short-lived between July 1993 and June 1997, although the whole period appears to be in a hot issue state.

Figure 7.2: Visually Identified Turning Points of GP in Australian IPO Sample



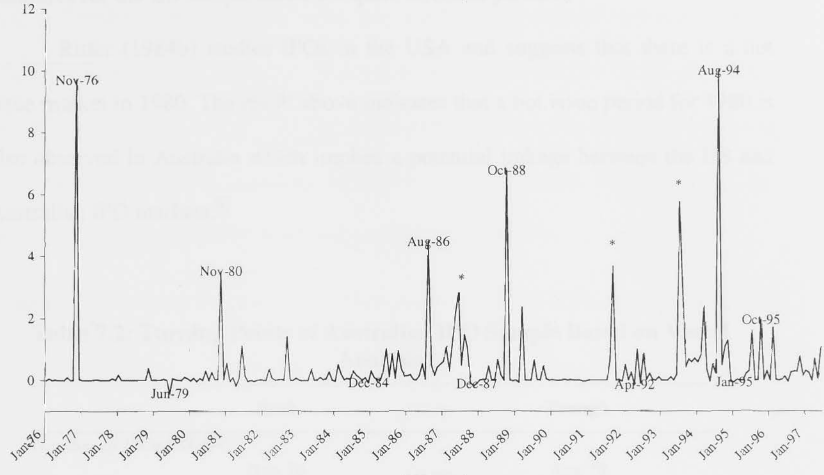
The identification of peaks and troughs in VWUP is somewhat difficult since VWUP shows quite a volatile pattern over the period (see Figure 7.3). Following a trough in June 1979, there appears to be a peak in July 1979 (see * symbol) but this point is eliminated since duration of this phase is less than six months. A peak in October 1988 seems to be followed by another peak in July 1989 (see + symbols) but the cycle duration is less than 15 months. In addition, it appears that there is a peak in June 1993 followed by a trough in August 1994 (see # symbol). However, the trough in August 1994 is too close to the next peak in September 1994. It appears that almost all the peaks identified represent abnormally large values in their specific cycles and are short-lived.

Figure 7.3: Visually Identified Turning Points of VWUP in Australian IPO Sample



Peaks and troughs for VUP are reported in Figure 7.4. The pattern of VUP appears to be relatively flat with only a few extreme fluctuations. Three peaks are eliminated (see * symbols) in the pattern as they are either less than six months for a phase or less than 15 months for a cycle. Although there are five peaks identified over the period, four of them (except October 1995) seem to be temporary movements in VUP.

Figure 7.4: Visually Identified Turning Points of VUP in Australian IPO Sample



Summarised results on turning points identified through visual analysis are reported in Table 7.2. For the two volume measures, seven peaks are observed in NOIPO and four are observed in GP. It appears that there is a linkage in peaks between the two volume measures. For instance, an identical peak in June 1981 is observed in both measures. Also, a peak observed in NOIPO in July 1987 is followed by a peak in October 1987 of GP; a peak observed in GP in July 1993 is followed by a peak in NOIPO in December 1993. This suggests a general consistency in pattern between the volume measures.

Comparison of the two underpricing measures shows that peaks identified in the two underpricing measures are somewhat correlated, especially after 1988. For instance, a peak for VUP in August 1994 is followed by a one-month delay in VWUP in addition to two identical peaks in November 1980 and October 1988.

This finding is in contradiction with the US results as the two underpricing measures for the US sample exhibited quite different patterns.

Ritter (1984b) studies IPOs in the USA and suggests that there is a hot issue market in 1980. The result above indicates that a hot issue period for 1980 is also observed in Australia which implies a potential linkage between the US and Australian IPO markets.[87]

Table 7.2: Turning Points of Australian IPO Sample Based on Visual Analysis

	Peak	Trough
Number of IPOs (NOIPO)		
	Nov 76	Aug 78
	Jun 81	Apr 83
	Aug 84	Apr 85
	Jul 87	Jan 88
	Dec 88	Jul 91
	Jul 92	Mar 93
	Dec 93	Apr 95
Gross Proceeds (GP)		
	Jun 81	Feb 82
	Sep 82	Apr 85
	Oct 87	Jul 91
	Jul 93	
Value-Weighted IPO Underpricing (VWUP)		
	Nov 76	Jun 79
	Nov 80	Aug 81
	Mar 84	Dec 84
	Aug 85	Dec 87
	Oct 88	Nov 90
	Sep 94	
Value of Underpricing (VUP)		
	Nov 76	Jun 79
	Nov 80	Dec 84
	Aug 86	Dec 87
	Oct 88	Apr 92
	Aug 94	Jan 95
	Oct 95	

[87] This issue of linkages across international IPO markets is explored in Chapter nine of this thesis.

7.3.2 The Bry and Boschan Method

Turning points selected by the Bry and Boschan method for the Australian sample are reported in Table 7.3. While five peaks are observed for NOIPO, there are only three peaks in GP. The decreased number of turning points identified in both volume measures (relative to visual analysis) might be caused by the smoothing process imposed by the Bry and Boschan method.

Table 7.3: Turning Points Identified in the Australian IPO Sample using the Bry and Boschan Method

	Peaks	Troughs
Number of IPOs (NOIPO)		
		Jul 80
	Jun 81	Nov 82
	July 87	Jan 88
	Mar 89	Jan 91
	Jul 92	Mar 93
	Dec 93	Mar 95
Gross Proceeds (GP)		
		Jan 77
	Oct 87	Feb 93
	Jul 93	Mar 95
	Nov 95	
Value-Weighted IPO Underpricing (VWUP)		
		Mar 80
	Aug 80	Aug 81
	Mar 84	Dec 84
	Aug 85	Mar 86
	Mar 87	Nov 87
	Oct 88	Nov 90
	May 91	Jun 92
	Sep 94	Jan 95
Value of Underpricing (VUP)		
		Feb 79
	Nov 80	Oct 81
	Sep 82	Feb 83
	Jun 85	Apr 86
	Jun 87	Nov 87
	Oct 88	Nov 90
	Sep 91	Nov 92
	Nov 94	Jan 95

For the two underpricing measures, seven peaks are reported under the Bry and Boschan method. These turning points exhibit some similarities to those identified under visual analysis. For instance, a peak in VWUP in August 1980 is followed by a peak in VUP in November 1980, a peak in VWUP in March 1987 is followed by a peak in VUP in June 1987, a peak in VWUP in May 1991 is followed by a peak in VUP in September 1991, and a peak in VWUP in September 1994 is followed by a peak in VUP in November 1994.

7.3.3 Markov Regime Switching Method

The parameter estimates of the Markov regime-switching model for each of the four series across the full sample are reported in Table 7.4. A common characteristic across all activity measures is the observation of higher means and standard deviations in hot periods than in cold periods which is consistent with the US results. For instance, the average proportion of the number of issues per month (NOIPO) in hot periods is 0.81% of the sample with a standard deviation of 0.07%. In comparison, the average proportion of the number of issues is six times lower in cold periods (0.14%) with a much lower standard deviation (0.02%). Such results clearly indicate the difference in regimes.

Similar differences between the regimes are obtained for GP where the average proportion of gross proceeds per month in hot periods is 0.99% of the sample compared to only 0.04% in cold periods. Again, the standard deviation is much higher in hot periods than cold periods (0.13% vs. 0.01%).

Table 7.4: Maximum Likelihood Estimates from the Markov Regime Switching Model for Australian IPO Sample January 1976 - June 1997

$$Y_t = a_{01}(1 - S_t) + a_{02}S_t + [\sigma_1(1 - S_t) + \sigma_2 S_t]\varepsilon_t$$

where S_t denotes the state of the world for hot ($S_t = 0$) and cold ($S_t = 1$) markets

	NOIPO		GP		VWUP		VUP	
Parameter	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1-q	0.0724*	0.0316	0.2840*	0.0547	0.7234*	0.1036	0.3577*	0.0724
1-p	0.0490*	0.0208	0.1736*	0.0343	0.2320*	0.0431	0.1245*	0.0221
a_{01}	0.8109*	0.0728	0.9850*	0.1273	64.9301*	12.8491	1.26748	0.0511
a_{02}	0.1374*	0.0177	0.0368*	0.0052	8.0900*	1.1001	0.0239*	0.0020
σ_1	0.6038*	0.0435	1.2153*	0.0876	87.9562*	8.1965	0.8536*	0.0042
σ_2	0.1395*	0.0157	0.0481*	0.0050	12.3097*	1.3266	0.0467*	0.0001

*denotes significance at 5% level.

The two underpricing measures also exhibit substantially different parameters between regimes. VWUP is 64.93% in hot periods on average and only 8.09% in cold periods. Similarly, VUP is 1.27% in hot periods compared to only 0.02% in cold periods. The associated standard deviations reflect similar patterns.

In summary, hot periods are characterised by substantially higher means and standard deviations than cold periods in all volume and underpricing measures.

Consistent with the research method used in Chapter six, transition rules are applied to the regime switching probabilities, such that a hot issue period is defined when there are at least six consecutive probabilities greater than 0.5. Using the regime probabilities and transition rules, hot and cold issue periods are identified and reported in Table 7.5. Although there are common hot periods in the two volume measures (NOIPO and GP), the starting and ending dates of hot periods in the two measures are slightly different. The expected duration of a hot issue period is 14 months using NOIPO and 4 months using GP.[88]

While four hot periods are observed for VUP, there are only two hot periods for VWUP. Hot periods appear less persistent in the VWUP measure. The expected duration of a hot period is only one month using VWUP but three months using VUP. Of note, the hot period identified by VWUP for November 1980 to May 1981 is consistent with the hot issue period observed by Ritter (1984b) using US data. This finding further supports the argument above that there exists a correlation between US and Australian IPO markets.

[88] Recall that the expected duration of each hot issue period can be calculated using $(1-q)^{-1}$ and conversely for cold issue cycles can be calculated as $(1-p)^{-1}$.

Table 7.5: Chronology of IPO Activity Based on Transition Probabilities from the Regime-Switching Model for Australian IPO Sample January 1976 - June 1997

Hot Periods	Cold Periods
Number of IPOs (NOIPO)	
	Jan 76 – Jan 84
Feb 84 – Dec 87	Jan 88 – Jun 92
Jul 92 – Feb 95	Mar 95 – Jul 96
Aug 96 – Jun 97	
Gross Proceeds (GP)	
	Jan 76 – May 85
Jun 85 – Nov 87	Dec 87 – Jul 91
Aug 91 – Sep 92	Oct 92 – Jun 93
Jul 93 – Jan 95	Feb 95 – May 96
Jun 96 – Jun 97	
Value-Weighted IPO Underpricing (VWUP)	
	Jan 76 – Oct 80
Nov 80 – May 81	Jun 81 – Jan 87
Feb 87 – Nov 87	Dec 87 – Jun 97
Value of Underpricing (VUP)	
	Jan 76 – Apr 85
May 85 – Nov 87	Dec 87 – Dec 91
Jan 92 – Jul 92	Aug 92 – Jun 93
Jul 93 – Nov 94	Dec 94 – Jul 96
Aug 96 – Jun 97	

Compared with the 7 peaks in VWUP selected by the Bry and Boschan method, the regime switching method only identified two hot issue periods in VWUP. The difference can be explained by the different criteria imposed by the methods. While the regime switching method identifies regime shifts using the full data set to form a judgement, the Bry and Boschan method selects the peaks based on a period of ±5 months. Figure 7.3 reveals that some short-lived upward movements in VWUP are not identified as hot issue periods by the regime switching method. For instance, temporary upward movements in 1988 and 1994 are not recognised as hot periods under the regime switching method. It also appears that in periods of high volatility where no clear cyclical patterns can be identified visually, the regime switching method tends to not identify these periods as hot issue periods - for instance, the period of August 1981 to December 1986 in VWUP, the periods August 1978-April 1983 and January 1988-July 1991 in NOIPO.

Of note, the crash of October 1987 again exhibits a strong influence with both volume and underpricing measures shifting from a hot state to a cold state during the period.

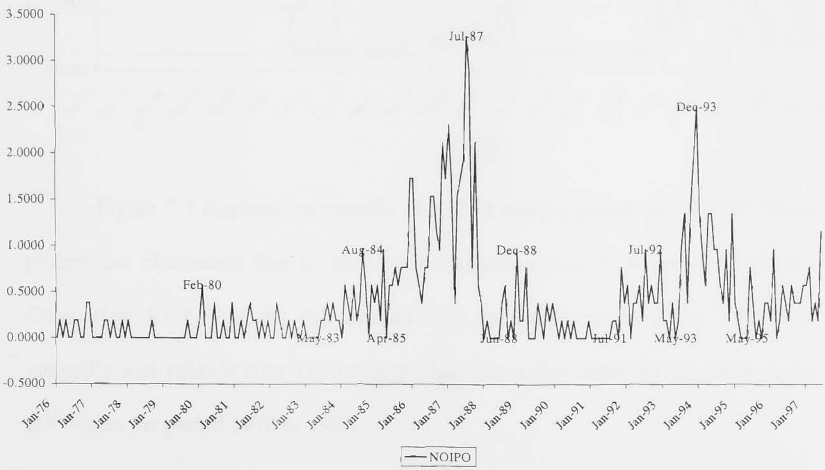
7.4 Empirical Results from the Industrial Sector IPOs

As discussed earlier, there are differences in features between resource and industrial sector IPOs. For instance, as indicated in Table 7.1, resource sector IPOs tend to be smaller, lower priced and experience greater underpricing in comparision to their industrial counterparts. Hence, a separate analysis is first conducted on industrial sector IPOs.

7.4.1 Visual Analysis

Figure 7.5 reports visually identified turning points for NOIPO for industrial IPOs. It is noted that the pattern of NOIPO for industrial sector IPOs is highly consistent with the full sample in Australia. The turning points of NOIPO identified in the industrial sector IPOs are almost identical to those identified in the full sample.

Figure 7.5: Visually Identified Turning Points of NOIPO in Australian Industrial Sector IPOs



The visually identified turning points for GP are presented in Figure 7.6. Compared with GP in the full sample, the pattern of GP in industrial sector IPOs exhibits a strong similarity. The peaks identified are almost identical for the period 1976 to 1990. The main difference is observed in 1987 with a peak for industrial sector IPOs ending two months before the crash while a peak in the full sample ends in October 1987. This suggests that the majority of new issues during the period of the stock market crash were natural resource sector issues.

Figure 7.6: Visually Identified Turning Points of GP in Australian Industrial Sector IPOs

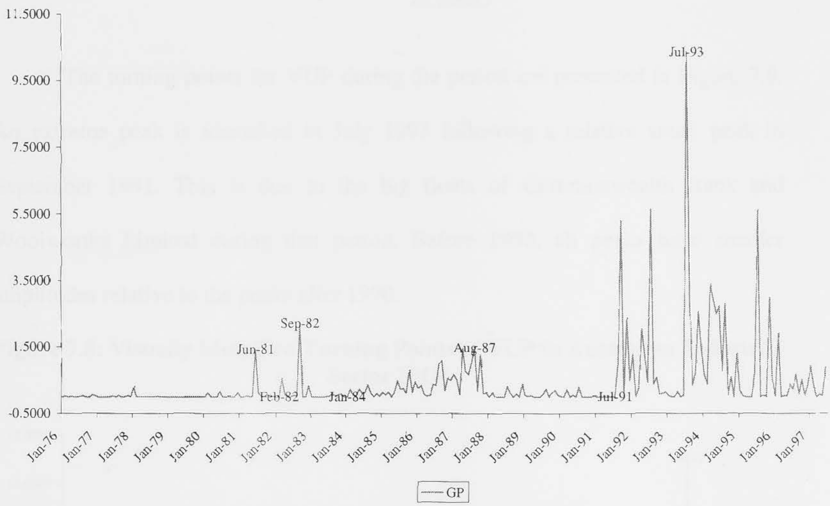
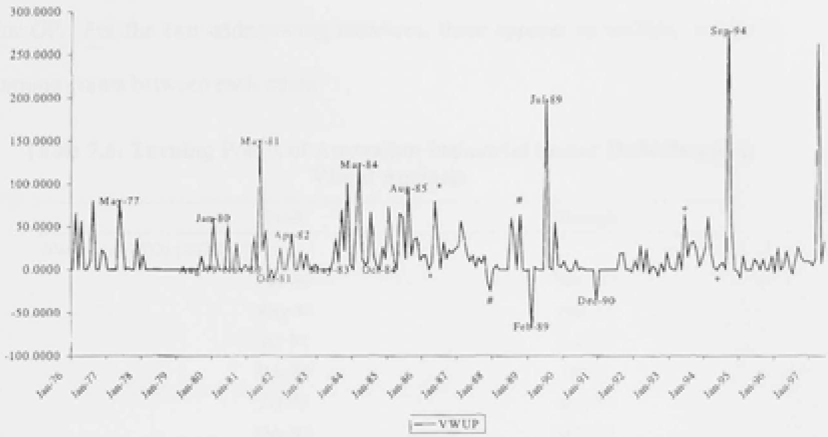


Figure 7.7 displays the visually identified turning points for VWUP. Three phases are eliminated due to their short durations (see *, # and + symbols). Comparing VWUP in the full sample with industrial sector IPOs, VWUP is generally less volatile after 1990 though there are a few large spikes. Most peaks fall within the period 1979 to 1985.

Figure 7.7: Visually Identified Turning Points of VWUP in Australian Industrial Sector IPOs



The turning points for VUP during the period are presented in Figure 7.8. An extreme peak is identified in July 1993 following a relative small peak in September 1991. This is due to the big floats of Commonwealth Bank and Woolworths Limited during that period. Before 1990, all peaks have smaller amplitudes relative to the peaks after 1990.

Figure 7.8: Visually Identified Turning Points of VUP in Australian Industrial Sector IPOs

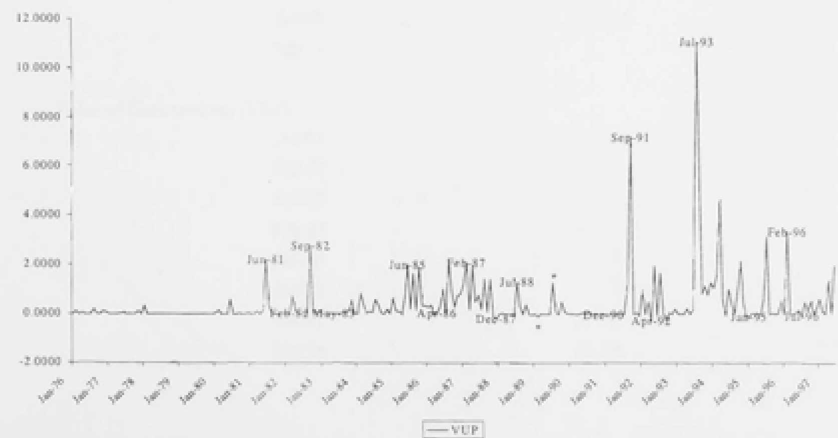


Table 7.6 reports summarized results on turning points identified by visual analysis. With six peaks identified for NOIPO, there are only four peaks identified for GP. For the two underpricing measures, there appears to be little linkage in turning points between each other.

Table 7.6: Turning Points of Australian Industrial Sector IPOs Based on Visual Analysis

	Peak	Trough
Number of IPOs (NOIPO)		
	Feb 80	May 83
	Aug 84	Apr 85
	Jul 87	Jun 88
	Dec 88	Jul 91
	Jul 92	May 93
	Dec 93	May 95
Gross Proceeds (GP)		
	Jun 81	Feb 82
	Sep 82	Jan 84
	Aug 87	Jul 91
	Jul 93	
Value-Weighted IPO Underpricing (VWUP)		
	May 77	Aug 79
	Jan 80	Nov 80
	May 81	Oct 81
	Mar 84	Oct 84
	Aug 85	Feb 89
	Jul 89	Dec 90
	Sep 94	
Value of Underpricing (VUP)		
	Jun 81	Feb 82
	Sep 82	May 83
	Jun 85	Apr 86
	Feb 87	Dec 87
	Jul 88	Dec 90
	Sep 91	Apr 92
	Jul 93	Jan 95
	Feb 96	Jul 96

Comparing Tables 7.2 and 7.6, the results of visual analysis suggest that the two volume measures for industrial sector IPOs are consistent in their peaks with that of the full sample. For instance, both select peaks in 1984, 1987, 1988, 1992 and 1993.

7.4.2 The Bry and Boschan Method

The turning points selected by the algorithm of the Bry and Boschan method are reported in Table 7.7. Although the turning points selected by the Bry and Boschan method are fewer than those identified by visual analysis, they exhibit a high degree of consistency when compared with those identified by visual analysis. For instance, both methods identify three identical peaks in NOIPO (July 1987, July 1992 and December 1993) and four in VUP (May 1981, August 1985, July 1989 and September 1994).

The peaks selected for the two volume measures exhibit a strong similarity with those peaks identified for the volume measures in the full sample. For instance, four identical peaks in NOIPO are noted in both industrial sector IPOs and the full sample (June 1981, July 1987, July 1992 and December 1993).

In conjunction with the results of visual analysis, the above suggests that the volume patterns of industrial sector IPOs generally reflect the volume pattern observed in the full sample. The implication is that Australian industrial sector IPOs dominate the aggregate Australian new issues market.

Table 7.7: Turning Points in Australian Industrial Sector IPOs using the Bry and Boschan Method

	Peaks	Troughs
Number of IPOs (NOIPO)		
		Feb 78
	Jun 81	Nov 82
	Jul 87	Nov 90
	Jul 92	Mar 93
	Dec 93	Mar 95
Gross Proceeds (GP)		
		Nov 78
	Jun 80	Jan 83
	Aug 87	Jan 88
	Aug 89	Aug 90
	Jul 93	Mar 95
	Jul 95	
Value-Weighted IPO Underpricing (VWUP)		
		Feb 78
	May 81	Nov 82
	Nov 83	Oct 84
	Aug 85	Mar 86
	Feb 87	Dec 87
	Jul 89	Dec 90
	Mar 92	Sep 92
	Sep 94	Jan 95
Value of Underpricing (VUP)		
		Dec 77
	Jun 81	Nov 82
	Jun 85	Mar 86
	Feb 87	Dec 90
	May 92	Sep 92
	Jul 93	Jan 95
	Feb 96	Jul 96

Consistent with the US results, Australian industrial sector IPOs suggest a lead-lag relationship in the turning points between the underpricing and volume measures. For instance, a peak in February 1987 in VUP is followed by a peak in July 1987 in NOIPO, a peak in May 1992 in VUP is followed by a peak in July 1992 in NOIPO, and a peak in July 1993 in VUP is followed by a peak in December 1993 in NOIPO. Although the two volume measures show a consistency in the turning points, the results for the underpricing measures are somewhat different and no clear linkage in the turning points between VWUP and VUP is observed.

7.4.3 Markov Regime Switching Method

Table 7.8 reports the parameter estimates of the Markov regime-switching model for each of the four series in the industrial sample. Consistent with Table 7.4 for the full sample, the results clearly indicate the difference in regimes where means and standard deviations of the IPO activity measures are much higher in hot periods than in cold periods. Again, the lower underpricing (VWUP) for industrial sector IPOs is apparent.

Table 7.8: Maximum Likelihood Estimates from the Markov Regime Switching Model for Australian Industrial IPOs January 1976 - June 1997

$$Y_t = a_{01}(1 - S_t) + a_{02}S_t + [\sigma_1(1 - S_t) + \sigma_2 S_t]\varepsilon_t$$

where S_t denotes the state of the world for hot ($S_t = 0$) and cold ($S_t = 1$) markets

	NOIPO		GP		VWUP		VUP	
Parameter	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1-q	0.0622*	0.0295	0.6234*	0.0240	0.4596*	0.1399	0.9835*	0.0018
1-p	0.0503*	0.0220	0.1640*	0.0113	0.2752*	0.0285	0.2751*	0.0244
a_{01}	0.7992*	0.0639	1.2562*	0.0720	42.5124*	5.6755	1.2916*	0.2606
a_{02}	0.0977*	0.0126	0.0274*	0.0041	1.8805*	0.9835	0.0208*	0.0071
σ_1	0.6307*	0.0437	1.3055*	0.0199	41.7006*	9.6312	1.6095*	0.1089
σ_2	0.1345*	0.0106	0.0484*	0.0026	4.2267*	1.8468	0.0516*	0.0096

*denotes significance at 5% level.

Hot and cold issue periods for industrial IPOs are identified and reported in Table 7.9 using the regime probabilities and transition rules following the earlier procedure.[89] The two volume measures, NOIPO and GP, exhibit similar hot issue periods to those identified in the full sample and are generally consistent with each other. One difference between the two measures is the period from August 1988 to April 1989, where NOIPO is in a hot state and GP is in a cold state.

The transition probability of moving from hot to cold periods for VWUP has decreased whereas for GP and VUP the transition probabilities of moving from hot to cold periods have increased. In other words, hot periods identified in VWUP are more persistent while hot periods identified in VUP and GP are less persistent for the industrial sector than for the IPO market as a whole. This feature is also reflected in estimates of σ_1 and σ_2 which have decreased, compared to the full sample, implying a decrease in the variability of VWUP in hot and cold periods. The implication again is that resource sector IPOs are relatively more underpriced and smaller in size compared to industrial IPOs. Hence, after removing the resource sector IPOs, VWUP becomes more stable. Of note, the hot and cold periods for NOIPO remain almost the same.

[89] Graphs of the estimated regime probabilities for the measures are not reported here but are available on request.

Table 7.9: Chronology of IPO Activity Based on Transition Probabilities from the Regime-Switching Model for Australian Industrial IPOs January 1976 - June 1997

	Hot Periods	Cold Periods
Number of IPOs (NOIPO)		
		Jan 76 – Jan 84
	Feb 84 – Jan 88	Feb 88 – Jul 88
	Aug 88 – Apr 89	May 90 – Oct 91
	Nov 91 – Jun 97	
Gross Proceeds (GP)		
		Jan 76 – Jan 84
	Feb 84 – Aug 84	Sep 84 – May 85
	Jun 85 – Oct 87	Nov 87 – Jul 91
	Aug 91 – Sep 92	Oct 92 – Jun 93
	Jul 93 – Jun 97	
Value-Weighted IPO Underpricing (VWUP)		
	Apr 76 – Jan 78	Feb 78 – Aug 79
	Sep 79 – Sep 82	Oct 82 – May 83
	Jun 83 – Dec 87	Jan 88 – Jun 88
	Jul 88 – May 90	Jun 90 – Jul 91
	Aug 91 – Jun 97	
Value of Underpricing (VUP)		
		Jan 76 – Oct 83
	Nov 83 – Dec 87	Jan 88 – Jul 91
	Aug 91 – Nov 94	Dec 94 – May 95
	Jun 95 – Jun 97	

The results again show the influence of the crash of October 1987, with all measures shifting from a hot state to a cold state soon thereafter. The two pricing measures, VWUP and VUP, identify a hot period between late 1983 and December 1987, ending two months after the crash. However, the ending months for the two volume measures vary. The hot period for NOIPO ends in January 1988 which is one month later than the pricing measures while GP ends in October 1987 which is two months earlier than the pricing measures. There are some implications that follow.

First, the number of IPOs measure (NOIPO) is not as dynamic in its response to the crash compared to the price based measure (GP). The persistence in NOIPO during adverse market conditions supports the argument that even if issuers respond to market conditions when timing decisions, the lag induced by institutional and regulatory requirements exposes issuers to the risk of making an issue during market downturns.

Second, the lagged response to the crash can also be explained by the Australian regulatory environment where there is a significant difference in elapsed times between the closing date of offer and actual date of listing on the ASX. Based on a survey of 243 IPOs listed on the ASX between 1993 and 1997, the average number of days elapsed between the closing date of offer and the first day of market trading is 25 days with a minimum of 3 days and a maximum of 133 days.[90] With the existence of significant elapsed times between the offer close and the subsequent listing date in Australia, a market downturn exposes an issuer to a greater risk of an 'unsuccessful' offer. Moreover, if the close of an offer is followed

[90] Data are obtained from SDC IPO database.

by a market downturn, the time before listing exposes investors to the risk where potential returns from the issue are less than their expected value.

Third, as indicated in Table 7.9, the response of GP to the crash in 1987 is quicker than NOIPO which suggests that IPOs issued immediately following the crash were mainly small issues. Indeed, the average size of issues following the crash through to January 1988 was A$8.7 million compared to an average across the sample period of A$44 million. Moreover, these issues were overpriced by an average of 13.0%. In a market downturn, large companies may have a greater capacity and incentive to withdraw their offers or indeed may be bound by stricter underwriting clauses which require withdrawal because of their size. The relative costs to small firms from withdrawal may necessitate the offer proceeding despite adverse market conditions.

Again, Table 7.9 reveals a possible lead-lag feature between the volume and underpricing measures where the hot issue period in the underpricing measures appear to lead the hot issue period in the volume measures. For instance, a hot period in VWUP commenced in June 1983 and is followed by a hot period in NOIPO in February 1984, a hot period commenced in VWUP in July 1988 and is followed by a hot period in NOIPO in August 1988, and a hot period in VWUP commenced in August 1991 and is followed by a hot period in NOIPO in November 1991.

7.5 Empirical Results from the Resource Sector IPOs

The analysis is now repeated on the sample of resource sector IPOs to shed light on the behaviour of resource sector IPOs. The aim is to explore the difference in behaviour between industrial and resource sector IPOs.

7.5.1 Visual Analysis

The visually identified turning points for NOIPO are exhibited in Figure 7.9. Compared to the industrial sector IPOs in Figure 7.5, the issuing pattern of resource issues is generally consistent with that of their industrial counterparts, except in the period 1978 to 1982. During this period, there are a relatively large proportion of resource issues with a peak observed in November 1980. A large peak is observed in September 1987 and is followed by a similar value in October 1987. In contrast with NOIPO in their industrial counterparts, this suggests that the majority of new issues around the period of the 1987 stock market crash were resource sector IPOs.

Figure 7.9: Visually Identified Turning Points of NOIPO in Australian Resource Sector IPOs

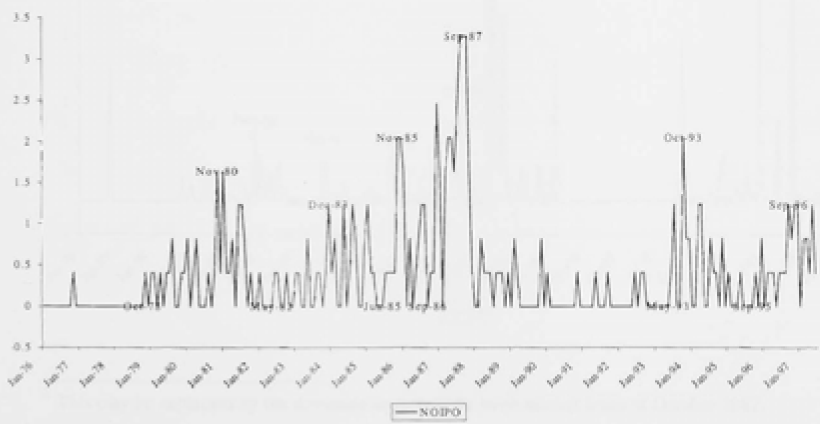
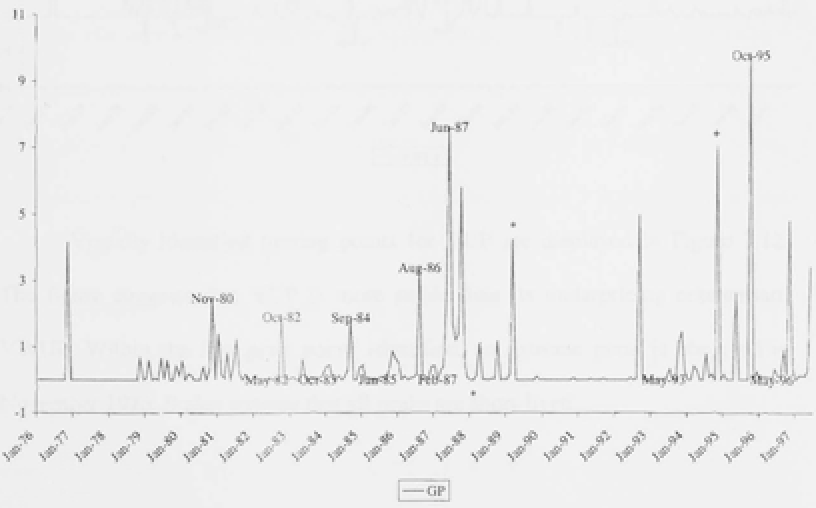


Figure 7.10 presents visually identified turning points for GP. Two peaks (March 1989 and November 1994) are eliminated as they fail to meet either the criteria of a minimum duration of six months for a phase or a minimum duration of 15 months for a cycle (see * and + symbols). Following a peak in June 1987, GP exhibits a decreasing trend. This suggests that resource sector IPOs generally have relatively smaller offer sizes after the 1987 market crash.[91] While the turning points of GP identified in industrial sector IPOs are highly consistent with those identified in the full sample, the turning points of GP in resource sector IPOs present little consistency compared to the full sample and the industrial sector. This suggests that the issuing size of the Australian IPO market is dominated by industrial sector IPOs while resource sector IPOs generally have smaller offer sizes.

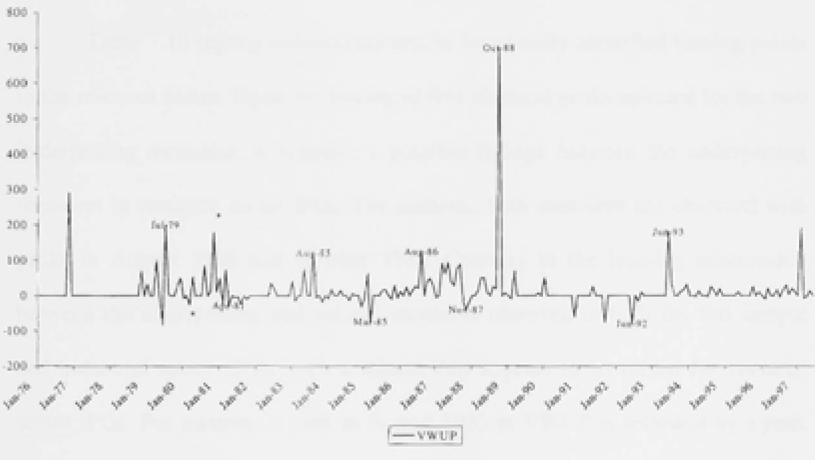
Figure 7.10: Visually Identified Turning Points of GP in Australian Resource Sector IPOs



[91] This may be explained by the downside impact of the stock market crash of October 1987.

Figure 7.11 presents turning points for VWUP in resource sector IPOs. A phase in VWUP between March and November 1980 is eliminated due to its short duration in cycle (see * symbols).[92] The turning points identified reveal neither a close relationship with those identified in the full sample or to those identified in the industrial sector. Generally, most turning points identified for VWUP in the resource sector fall between 1979 and 1988.

Figure 7.11: Visually Identified Turning Points of VWUP in Australian Resource Sector IPOs



Visually identified turning points for VUP are displayed in Figure 7.12. The figure suggests that VUP is more stable than its underpricing counterpart, VWUP. Within the five peak points identified, an extreme point is observed in November 1976. It also appears that all peaks are short-lived.

[92] Following a trough in March 1980, the next trough in April 1981 has a duration of only 13 months.

Figure 7.12: Visually Identified Turning Points of VUP in Australian Resource Sector IPOs

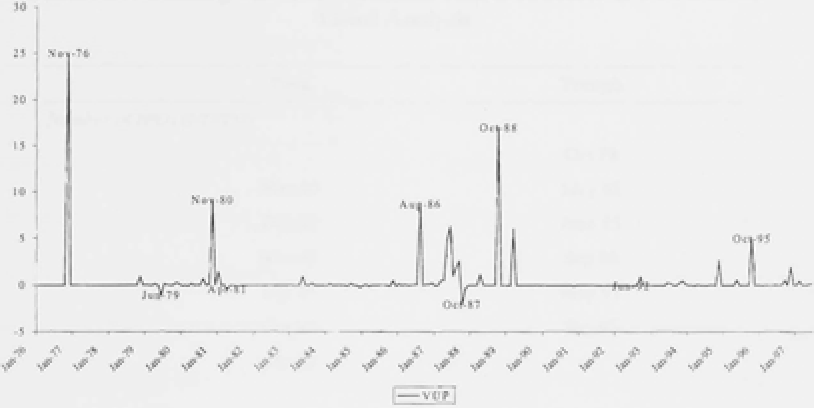


Table 7.10 reports summarised results for visually identified turning points in the resource sector. Upon the finding of five identical peaks selected for the two underpricing measures, it suggests a possible linkage between the underpricing measures in resource sector IPOs. For instance, both measures are observed with peaks in August 1986 and October 1988. Contrary to the lead-lag relationship between the underpricing and volume measures observed in both the full sample and industrial sector IPOs, such a relationship appears to be mixed for resource sector IPOs. For instance, a peak in August 1983 in VWUP is followed by a peak in December 1983 in NOIPO, but a peak in October 1988 in VWUP follows a peak in September 1987 in NOIPO.

Comparing Tables 7.2 and 7.10, peaks in VUP selected for the resource sector are almost identical to those selected for the full sample. With six peaks selected for VUP of the full sample, five of them appear to be associated with peaks in VUP of the resource sector (i.e. November 1976, November 1980, August 1986, October 1988 and October 1995).

Table 7.10: Turning Points of Australian Resource Sector IPOs Based on Visual Analysis

	Peak	Trough
Number of IPOs (NOIPO)		
		Oct 78
	Nov 80	May 82
	Dec 83	June 85
	Nov 85	Sep 86
	Sep 87	May 93
	Oct 93	Sep 95
	Sep 96	
Gross Proceeds (GP)		
	Nov 80	May 82
	Oct 82	Oct 83
	Sep 84	Jun 85
	Aug 86	Feb 87
	Jun 87	May 93
	Oct 95	May 96
Value-Weighted IPO Underpricing (VWUP)		
	Jul 79	Apr 81
	Aug 83	Mar 85
	Aug 86	Nov 87
	Oct 88	Jun 92
	Jun 93	
Value of Underpricing (VUP)		
	Nov 76	Jun 79
	Nov 80	Apr 81
	Aug 86	Oct 87
	Oct 88	Jun 92
	Oct 95	

7.5.2 The Bry and Boschan Method

Tuning points selected by the algorithm of the Bry and Boschan method are reported in Table 7.11. Only two peaks are selected in NOIPO under this method compared to six peaks identified under visual analysis (see Table 7.10). This may be explained by the smoothing process in the Bry and Boschan method. With a majority of the sample months experiencing no issue (138 out of 258 months), the amplitudes of extreme values are decreased through the smoothing process.

Turning points in GP selected by the Bry and Boschan method are highly consistent to those identified by visual analysis. However, the linkage of turning points in GP is somewhat weak between industrial and resource sector IPOs.

The two underpricing measures give different results to each other. The dates of the peaks are different between the measures. It is also noted that the results of the underpricing measures are quite different to those in the full sample and industrial sector.

In summary, the results of each IPO activity measure in resource sector IPOs show little consistency to those of full sample and industrial sector IPOs. Further, there is little evidence of a lead-lag relationship between the underpricing and volume measures.

Table 7.11: Turning Points of Australian Resource Sector IPOs using the Bry and Boschan Method

	Peaks	Troughs
Number of IPOs (NOIPO)		
		Oct 76
	Aug 87	Dec 89
	Oct 93	Apr 95
Gross Proceeds (GP)		
		Oct 76
	Jun 79	Feb 80
	Nov 80	Dec 81
	Oct 82	Apr 83
	Sep 84	Apr 85
	Jun 87	Jul 88
	Oct 95	
Value-Weighted IPO Underpricing (VWUP)		
		Oct 76
	Jul 79	Apr 81
	Aug 83	Mar 85
	May 87	Nov 87
	Oct 88	Jun 92
Value of Underpricing (VUP)		
		Jun 79
	Nov 80	Apr 81
	May 83	Dec 84
	Jun 87	Jun 92
	Sep 92	Jul 94
	Oct 95	Feb 96

7.5.3 *Markov Regime Switching Method*

The parameter estimates of the Markov regime-switching model for each of the four resource sector series are reported in Table 7.12. Consistent with Tables 7.4 and 7.8, the results clearly indicate the difference in regimes where hot issue periods are characterised by substantially higher means and standard deviations in all measures.

Table 7.12: Maximum Likelihood Estimates from the Markov Regime Switching Model for Australian Resource IPOs January 1976 - June 1997

$$Y_t = a_{01}(1-S_t) + a_{02}S_t + [\sigma_1(1-S_t) + \sigma_2 S_t]\varepsilon_t$$

where S_t denotes the state of the world for hot ($S_t = 0$) and cold ($S_t = 1$) markets

	NOIPO		GP		VWUP		VUP	
Parameter	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1-q	0.3363*	0.0969	0.7614*	0.0880	0.5908*	0.0862	0.5098*	0.1052
1-p	0.1413*	0.0331	0.1164*	0.0407	0.1879*	0.0430	0.4873*	0.0864
a_{01}	1.0439*	0.1212	1.3327*	0.1388	35.1973*	4.2992	2.0090*	0.4252
a_{02}	0.1192*	0.0165	0.0136*	0.0067	3.3225*	0.0367	0.0306	0.0180
σ_1	0.7459*	0.0631	1.5620*	0.0353	60.7196*	0.4889	3.6022*	0.0849
σ_2	0.1885*	0.0119	0.0457*	0.0153	5.6330*	0.4456	0.1170*	0.0278

*denotes significance at 5% level.

Hot and cold periods for resource IPOs are identified from estimated regime probabilities and are reported in Table 7.13.[93] Hot periods identified in NOIPO are not as persistent as those identified in the full sample and industrial sector IPOs. Consistent with Tables 7.5 and 7.9, the two volume measures, NOIPO and GP, are somewhat consistent with each other. However, while the volume measures show some common hot issue periods to those identified in both the full sample and the industrial sector, the degree of the consistency is somewhat weak. The results imply that the number of issues in the resource sector is not as strongly correlated with the overall market as the industrial sector. In addition, the hot issue periods in the resource sector do not last as long as hot periods in the industrial sector.

The underpricing measures exhibit few hot issue periods common to those identified in the full sample or industrial sector, especially in VWUP. The inconsistency of hot issue periods in VWUP between industrial and resource sector IPOs may explain why there are only two hot issue periods in VWUP identified for full sample. This also supports the argument that resource sector IPOs have an influence on the pricing measures of IPO activity.

Most surprisingly, the market crash of October 1987 has little (or no) impact on resource sector IPOs. The earlier response to the 1987 market crash is in NOIPO where a hot period ends six months after the crash. For the rest of the measures, the influence of the crash is minimal. The hot issue periods for GP, VWUP and VUP end in March 1989 which exhibits a fifteen-month delay in response to the crash. The finding has two implications.

[93] Graphs of estimated regime probabilities are not reported here but are available on request.

Table 7.13: Chronology of IPO Activity Based on Transition Probabilities from the Regime-Switching Model for Australian Resource IPOs January 1976 - June 1997

Hot Periods	Cold Periods
Number of IPOs (NOIPO)	
	Jan 76 – Oct 80
Nov 80 – Aug 81	Sep 81 – Nov 83
Dec 83 – Feb 85	Mar 85 – Oct 85
Nov 85 – Apr 88	May 88 – Jun 93
Jul 93 – Nov 94	Dec 94 – Aug 96
Sep 96 – June 97	
Gross Proceeds (GP)	
	Jan 76 – Oct 78
Nov 78 – Oct 81	Nov 81 – Nov 83
Dec 83 – Jan 85	Feb 85 – Jul 86
Aug 86 – Mar 89	Apr 89 – Jun 93
Jul 93 – June 97	
Value-Weighted IPO Underpricing (VWUP)	
	Jan 76 – Oct 78
Nov 78 – Aug 81	Sep 81 – May 82
Jun 82 – Nov 83	Dec 83 – Jul 84
Aug 84 – Mar 85	Apr 85 – Oct 85
Nov 85 – Mar 89	Apr 89 – Aug 96
Sep 96 – Jun 97	
Value of Underpricing (VUP)	
	Jan 76 – Jul 80
Aug 80 – Apr 81	May 81 – Feb 87
Mar 87 – Mar 89	Apr 89 – Aug 96
Sep 96 – June 97	

First, it supports the argument that the valuation of resource sector IPOs is more difficult than their industrial counterparts due to a higher degree of information asymmetry and uncertainty. A market downturn further increases the degree of information asymmetry and uncertainty in the valuation of resource sector IPOs. As a result, the issuers of resource companies may gamble on the possible gains arising from higher information asymmetry and uncertainty by risking a public float in periods of market downturns.

Second, as shown in Table 7.1, resource sector IPOs are generally smaller in size. The relative costs of withdrawal to small resource IPOs may force the issuers of resource companies to accept the risk of adverse market conditions. A similar point has also been argued earlier in Section 7.4.

7.6 Explanatory Relationships

The above results suggest a casual observation that there are some possible lead-lag features between volume and underpricing measures (e.g. Tables 7.7 and 7.9). Specifically, hot periods in the underpricing measures appear to lead hot periods in the volume measures. For instance, in Table 7.9 a hot period in VWUP commenced in June 1983 and is followed by a hot period in the volume measures in February 1984, a hot period commenced in VWUP in July 1988 and is followed by a hot period in NOIPO in August 1988, and a hot period commenced in August 1991 in the underpricing measures and is followed by a hot period in NOIPO in November 1991. These are just casual observations and we now turn to statistical analysis of the relationships between the measures.

To examine the relationship between the IPO activity measures, a standard OLS approach is used:

$$NOIPO_t = C_1 + \sum_{j=-6}^{n} a_j VWUP_{t-j} + \varepsilon_t$$

$$GP_t = C_2 + \sum_{j=-6}^{n} b_j VWUP_{t-j} + \omega_t$$

Where

C_1 and C_2 are the constant;

n is the number of leads and lags;

ε_t and ω_t are the normally distributed error terms.

Table 7.14 reports the regression results between current, lead and lagged series of VWUP against the volume measures for the full sample. There is some evidence that underpricing leads IPO volume as evidenced by the significant lags of VWUP on NOIPO (at lags 2 and 5). In relation to GP, there is a significant negative correlation at VWUP lead of 2 and lag of 6 but we do not place much emphasis on these results as suggested by the insignificant F-statistic.

Table 7.14: Regression Results of Lead-lag Relationship between VWUP, NOIPO and GP for Australian IPO Sample

	NOIPO		GP	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Constant	0.2822*	0.0844	0.5203*	0.1402
VWUP Lead 1	-0.0003	0.0004	-0.0008	0.0006
VWUP Lead 2	0.0001	0.0005	-0.0011*	0.0005
VWUP Lead 3	-0.0004	0.0006	-0.0003	0.0006
VWUP Lead 4	-0.0003	0.0006	-0.0009	0.0006
VWUP Lead 5	0.0003	0.0007	-0.0007	0.0008
VWUP Lead 6	0.0003	0.0005	0.0004	0.0009
VWUP	0.0005	0.0004	-0.0002	0.0005
VWUP Lag 1	0.0005	0.0007	0.0010	0.0014
VWUP Lag 2	0.0014*	0.0006	0.0004	0.0006
VWUP Lag 3	0.0008	0.0008	-0.0004	0.0006
VWUP Lag 4	0.0011	0.0007	-0.0006	0.0006
VWUP Lag 5	0.0013*	0.0006	-0.0002	0.0008
VWUP Lag 6	0.0005	0.0006	-0.0012*	0.0006
F-statistic	1.0925		0.3246	
R-square	0.0609		0.0189	

Notes:

1. Standard errors are adjusted for autocorrelation and heteroscedasticity using the Newey-West correction.
2. * denotes significance at 5% level

The evidence is stronger for the industrial sector as presented in Table 7.15. From this table there is a contemporaneous correlation between the VWUP and NOIPO. While the leads of VWUP show no correlation with NOIPO up to six months, the lags of VWUP are correlated with NOIPO up to six months although the first two lags of VWUP are not significant. Hence, underpricing appears to lead IPO volume by up to six months. This finding supports the argument that the decision to issue is a function of current observed underpricing (Rock 1986; Firth, 1997).

Table 7.15: Regression Results of Lead-lag Relationship between VWUP, NOIPO and GP for Australian Industrial Sector IPOs

	NOIPO		GP	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Constant	0.1250	0.0760	0.3645*	0.1426
VWUP Lead 1	-0.0001	0.0007	-0.0018*	0.0009
VWUP Lead 2	0.0007	0.0009	-0.0020	0.0011
VWUP Lead 3	0.0005	0.0008	-0.0002	0.0012
VWUP Lead 4	0.0002	0.0011	-0.0021	0.0011
VWUP Lead 5	0.0009	0.0010	0.0008	0.0019
VWUP Lead 6	-0.0009	0.0009	0.0025	0.0022
VWUP	0.0019*	0.0008	-0.0001	0.0007
VWUP Lag 1	0.0004	0.0007	0.0004	0.0012
VWUP Lag 2	0.0020	0.0011	0.0019	0.0014
VWUP Lag 3	0.0023*	0.0009	-0.0008	0.0010
VWUP Lag 4	0.0027*	0.0013	-0.0001	0.0012
VWUP Lag 5	0.0043*	0.0016	0.0007	0.0013
VWUP Lag 6	0.0032*	0.0016	-0.0013	0.0011
F-statistic	3.3220*		0.6020	
R-square	0.1754		0.0371	

Notes:
1. Standard errors are adjusted for autocorrelation and heteroscedasticity using the Newey-West correction.
2. * denotes significance at 5% level.

Although this lead-lag relationship between VWUP, GP and NOIPO is less apparent for resource sector IPOs, the analysis still follows and the results are reported in Table 7.16. There is little evidence that underpricing leads IPO volume in the resource sector as evidenced by only one significant lag of VWUP on NOIPO (at lag 4). In relation to GP, there is a significant negative correlation at VWUP lead of 4 and significant positive correlation at current VWUP and lag of 5. Again, these results are not statistically important as suggested by the F-statistics.

Table 7.16: Regression Results of Lead-lag Relationship between VWUP, NOIPO and GP for Australian Resource Sector IPOs

	NOIPO		GP	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Constant	0.2634*	0.0535	0.2845*	0.0844
VWUP Lead 1	0.0003	0.0003	-0.0001	0.0011
VWUP Lead 2	0.0007	0.0005	-0.0009	0.0008
VWUP Lead 3	0.0001	0.0005	-0.0014	0.0008
VWUP Lead 4	-0.0002	0.0006	0.0007	0.0013
VWUP Lead 5	0.0002	0.0005	0.0000	0.0006
VWUP Lead 6	0.0002	0.0005	-0.0005	0.0005
VWUP	0.0017	0.0012	0.0040	0.0022
VWUP Lag 1	0.0010	0.0011	0.0011	0.0015
VWUP Lag 2	0.0010	0.0009	0.0009	0.0013
VWUP Lag 3	0.0007	0.0009	0.0003	0.0010
VWUP Lag 4	0.0023*	0.0012	0.0002	0.0005
VWUP Lag 5	0.0014	0.0010	0.0039*	0.0012
VWUP Lag 6	0.0004	0.0007	0.0000	0.0005
F-statistic	2.6514		1.8278	
R-square	0.1294		0.0929	

Notes:
1. Standard errors are adjusted for autocorrelation and heteroscedasticity using the Newey-West correction.
2. * denotes significance at 5% level.

The most common hot issue period observed across all measures of IPO activity is around mid 1991 to June 1997. This period is the longest of all hot periods documented over the sample. As with the transition to the cold period associated with the crash of October 1987, there appears to be a correlation between IPO activity and stock market conditions.[94] For instance, from the early 1990s it is widely recognised that the stock market has been experiencing a sustained bull run during which market indicators and price-earnings ratios have risen substantially and dividend-to-price ratios have fallen.[95] Other factors which may also be relevant include investor sentiment, the regulatory environment, the economic climate, interest rates, managed fund flows and the level of stock market volatility. The importance of these variables on the cycles in the IPO activity will be examined in the next chapter.

7.7 Conclusion

In this chapter, I have analysed the aggregate behaviour of the Australian IPO market. The aim is to analyse the existence of hot and cold issue periods in the Australian market. Through the development of a series of activity variables, different characteristics of the market are examined, focussing on volume and underpricing of new issues. More importantly, the influence of the resource sector is demonstrated and explored.

[94] Of note, Choe et al. (1993) document that the frequency of seasoned offerings also rises in economic upturns using US data from 1971 to 1991. They identify a positive relationship between equity issue volume and economic activity arguing that firms will issue equity when the effects of adverse selection, as a proportion of investment returns, are less important in the situation of improved business conditions.

[95] During the period 1991 to 1999, the All Ordinaries index increased from 1279.82 to 3152.50 and the price-earnings ratio increased from 11 to 26.76. Over the same period, the market dividend yield decreased from 7.0% to 3.18%.

Generally, the patterns of the volume measures are found to be consistent to each other for both the full sample and industrial sector IPOs albeit with some slight differences. This suggests that industrial sector IPOs dominate Australian new issues in terms of both number of issues and values.

Resource sector issues are found to be relatively small in size and price, and exhibit greater underpricing. Generally, each of the four measures in the resource sector exhibit different hot issue periods and turning points when compared with those in the full sample and industrial sector. Although there appears a weak linkage between the two volume measures, a lead-lag relationship between underpricing and volume measures is not observed. Moreover, the 1987 market crash is found to have little impact on the four measures of IPO activity for resource sector IPOs. Further, it appears that resource sector IPOs exhibit a substantial influence on the pricing measures of overall IPO market activity.

Through the application of a number of methods, regime switches are documented between hot and cold issue markets over the period 1976 to 1997. In summary, hot issue periods appear to exist in the Australian IPO market and are characterised initially by a large degree of underpricing followed by unusually high new issue volume. The activity measures studied here indicate that different periods may be characterised by differences in the types of issues. While the number of issues and total size of issues in each month are generally correlated, at times the measures of underpricing yield different results. Hot issue periods appear related to the general stock market conditions, which supports the hypothesis that managers time their issues to attempt to take advantage of favourable market conditions. However, this timing comes at a risk for both issuers and investors due to the institutional and regulatory requirements in Australia. Importantly, a lead-lag relationship is identified, particularly for the industrial sector, such that underpricing measures lead volume by up to six months.

CHAPTER EIGHT[96]

EXPLANATIONS ASSOCIATED WITH CYCLES IN THE IPO MARKET

8.1 Introduction

The extant literature has generally documented the existence of hot and cold IPO markets but offered little explanation for them. More recently, some economic variables have been suggested as possible explanations for the cyclical behaviour. For instance, Ljungqvist (1995) provides evidence that the number of IPOs changes over time in line with the business cycle and stock market conditions in Germany. Choe et al. (1993) find that, in the USA, periods of economic growth are associated with greater volume of seasoned equity issues. Rees (1997) provides evidence that the stock market condition predicts both the value and the volume of IPOs in the UK market. In addition, studies into seasoned equity offerings by Lucas and McDonald (1990), Taggart (1977), Marsh (1982) and Smith (1977) provide theoretical and empirical support for the argument that equity issues tend to follow stock market rises.

In this chapter, these explanations are discussed and subsequent hypotheses relating to the cyclical nature of IPO activity are developed. These hypotheses are

[96] In addition to my supervisors, Tim Brailsford and Richard Heaney, I would like to thank Simon Wheatley and Vincent Warther for providing their investor sentiment data, John Powell for his valuable advice on the development of hypotheses and Adrian Pagan for his constructive comments on research techniques in this chapter.

tested using both OLS and probit analysis. Chapter five has developed four measures of IPO activity. NOIPO and GP measure IPO Volume, VWUP and VUP measure IPO underpricing. Due to the similarity of the measures in IPO volume and in underpricing, the analysis conducted in this chapter concentrates on one measure of volume (NOIPO) and one measure of underpricing (VWUP).

8.2 Development of Hypotheses

The existence of hot and cold IPO markets implies variation, or expected variation, in market conditions. Further, evidence from Chapters six and seven suggests that IPO activity may be correlated with economic and stock market conditions. Thus, hypotheses are developed with consideration of relevant economic and stock market variables.

8.2.1 Hypotheses Related to Economic Activity

Empirical evidence also shows a strong link between the stock market and economic activity. For instance, Samuelson (1966) claims that the stock market is a reliable forecaster of the business cycle in the USA. In the following sub-sections, business cycle indicators that measure economic conditions are suggested as possible explanations of hot issue markets.

8.2.1.1 Business Cycle[97]

The business cycle reflects movements in economic activity as a whole and consists of many diverse parts. The relationship between the equity market and the business cycle is well documented in the literature (e.g. Moore 1961; Samuelson 1966; Fama 1981; Siegel 1991).

Bulmash and Trivoli (1991) suggest that economic expansions are associated with increased use of productive capacity and increased employment which eventually brings wage increases. Based on the theory of Cost-Push inflation, rising wages in turn increase consumer spending (see Lipsey et al. 1986, Wachter 1974; Seelig 1974). The implication is that demand for equity increases as a result of increased spending and this in turn drives up stock prices, in general.

Assuming a primary goal of issuers is to maximise the proceeds from IPOs, rational issuers would take advantage of the opportunity of increased demand for equity by timing their issues. If enough firms follow this strategy, an increased number of offerings are expected during economic expansions.

Choe et al. (1993) develop a model where firms choose between issuing equity and debt across business cycle expansions and contractions. They observe that, in general, the frequency of seasoned offerings is positively associated with business cycle variables (see also Myers and Majluf 1984).[98]

An improvement in economic conditions signals good prospects of future business conditions with greater growth opportunities, and firms are less likely to

[97] Industrial production is generally used as an alternative proxy for long-term growth trends in the economy (Elton and Gruber 1995). During the period of January 1976-June 1998, the correlation between industrial production and business cycle index is 0.897. Due to this high correlation between the two indices, we focus on the broader business cycle index.

[98] Several business cycle variables are used in Choe et al. (1993), such as business cycle leading indicator and the growth rate of industrial production.

forego these growth opportunities (Choe et al. 1993). Subsequently, companies alter their business strategies and investment decisions to optimise growth opportunities. For instance, companies increase production and improve productivity. As a result, expected future cash flows increase. Since the theoretical stock price of a company is equal to the discounted sum of expected future cash flows and in turn, the magnitude of cash flows is dependent on the strength of the economy, equity prices should reflect expectations of future economic activity. In other words, an upward revision in expectations of future economic conditions should result in higher equity prices. Therefore, we posit that

> *H1a: Changes in economic condition (as measured by the business cycle index) are positively related to, and lead, the level of NOIPO.*

In the IPO process, IPO issuers cannot act instantaneously since there is generally a three- to six-month period between commencing the IPO process and consequently going public (Lipman 1997). When the decision is made to issue an IPO, the issuer needs to forecast the future condition of the IPO market at the expected listing date based on the current information set. This information set includes current stock market and economic conditions. After the offer price is set, it becomes difficult to change. In other words, the offer price is set based on the current and expected economic and stock market conditions at the date of price setting. As discussed above, an upward revision in the expectations of future economic conditions after the initial IPO price setting should lead to a higher stock price. Hence, an unexpected increase in economic conditions, after the date of setting the initial offer price, should result in a higher aftermarket price for the IPO. As a result, higher IPO underpricing is expected on listing. Therefore, we posit that there is a positive relation between changes in economic conditions and IPO underpricing.

H1b: Changes in economic condition (as measured by the business cycle index) are positively related to, and lead, the degree of VWUP.

8.2.2 Hypotheses Related to Stock Market Conditions

It is argued that the first response to a change in business conditions occurs in the capital market, especially in the stock market where investors evaluate the impact of the change on their wealth. The change in business conditions should result in a revision of investor expectations and consequently alter the prices of bonds and stocks. Thus, a capital market signal occurs. Managers in turn react to the capital market signal by altering their investment decisions, strategies and production (Krainer 1992).

8.2.2.1 Changes in the Stock Market Level

There are a variety of circumstances which can lead to a decision to go public. Loughran et al. (1994) examine IPO underpricing and the long run performance of IPOs in 15 international markets and argue that IPOs are timed to take advantage of windows of opportunity. Since there are periods when investors place high valuations on the future growth opportunities of companies, companies are more likely to go public during these periods. Loughran et al. (1994) provide evidence of a correlation between the level of the stock market and the number of IPOs in 14 out of 15 countries. Rees (1997) also provides empirical evidence of the stock market effects on both the number and the value of IPOs.[99] However, both Loughran et al. (1994) and Rees (1997) fail to explain why a relation should exist between the IPO activity and stock market conditions.

In this study, we provide two alternative hypotheses on the relationship between IPO activity and changes in the stock market. The first hypothesis is associated with the empirical finding of the importance of underwriter reputation in the process of an IPO, and the second hypothesis is based on the existence of information asymmetry in the IPO market. While the first hypothesis addresses the relationship between the number of IPOs and changes in the stock market level, the second hypothesis discusses the relationship between IPO underpricing and changes in the stock market level.

It is evident that underwriters with a good reputation generally have little incentive to underwrite small, speculative and start-up firms (Booth and Smith 1986; Beatty and Ritter 1986; Tinic 1988; Wolfe et al. 1994). The phenomenon can be explained by the potential for undersubscribed offerings due to the impact of adverse price movements. A downward change in market conditions will create adverse price movements on or after the offer date. This may lead the market value of an IPO to fall below the offer price and result in an undersubscribed offering (Wolfe et al. 1994). In a rising stock market, however, the probability of an adverse price movement on or after the offering date is lower. Hence, prestigious underwriters will be more receptive to expanding their participation in the new issue market during such periods (Wolfe et al. 1994). This should encourage more small and speculative start-up firms to go public during a bullish

[99] Loughran et al. (1994) use annual IPO volume to measure IPO activity while Rees (1997) uses quarterly data. In this thesis, IPO activity is measured on a monthly basis.

market. As a result, an increase in IPO volume is expected in periods when the stock market is rising.

H2a: Changes in the stock market level are positively related to, and lead, the level of NOIPO.

Rock (1986) has developed a model to explain IPO underpricing that relies on information asymmetry between informed and uninformed investors. He argues that an adverse selection problem arises when a purchase order is submitted. Only uninformed investors will submit a purchase order in the event of an overpriced issue (offer price greater than true value of an issue), while both informed and uninformed investors will submit purchase orders in the event of an underpriced issue. Although Rock's model does not consider the impact of the stock market conditions on new issues, his theory has empirical implications. Informed investors can obtain the true value of an issue by conducting costly security analysis which involves estimation of the IPO value (Ritter 1984b). However, such value estimates are obtained with error.

To explain, assume management in an issuing company has an information advantage (e.g. Baron 1982; Rock 1986). They know the true value of their IPO (p_1) and subsequently set an offer price for their IPO at p_2. Hence the expected underpricing of the IPO is $[(p_1-p_2)/p_2]$ by the issuing company.[100] It is well documented in the literature that in a rising stock market, investors are over-optimistic about the future growth of the company and place a higher valuation on the company's stock (e.g. Siegel 1992; Loughran et al. 1994). Hence, the valuation of the company's shares to investors is p_3 (where $p_3 > p_1$). In the aftermarket,

[100] Note that this argument assumes that management in the issuing company is uncertain about the future level of the stock market.

investors who could not obtain their desired allocations of the issue in the primary market will bid up the price of the share to a price close to or higher than p_3. As a result, underpricing is approximately $[(p_3-p_2) / p_2]$ in the aftermarket which is higher than the issuer's expected degree of underpricing, $[(p_1-p_2) / p_2]$ because $p_3 > p_1$. Therefore, we posit that there is a positive relationship between IPO underpricing and changes in the stock market level.

H2b: Changes in the stock market level are positively related to, and lead, the degree of VWUP.

8.2.2.2 Stock Market Volatility

The impact of stock market volatility on IPO activity can be explained by exploring the relationship between underwriting fees and IPO activity using an option pricing model. Smith (1977, 1986) points out that in a firm commitment contract,[101] the offering of new shares at a fixed price is analogous to the sale of a call option to investors. Investors have the right but not the obligation to purchase the shares from the underwriter at the offer price. Since the underwriter takes ownership of the shares before the offer to the public and is obligated to hold any unsold shares in the case of an unsuccessful issue, it represents a covered call position for the underwriter and can be modeled as a put option (Barry et al. 1991).

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[101] Another type of contract available in the USA is best efforts contract. The best efforts contract is normally used by small and speculative firms and accounts for only a small portion of total funds raised in the US market (Loughran et al. 1994). This type of contracts has become less frequently used over the 1990s.

The owner of a put option benefits from price decreases but has limited downside risk in the event of price increases. This implies that an increase in stock market volatility would lead underwriters to charge higher underwriting fees to compensate for taking higher risks.

Since underwriters may charge higher fees for IPOs in periods of high stock market volatility, the incentives of companies going public during these periods decreases due to relatively higher costs of the offering. Consequently, the incidence of new issues will fall when stock market volatility is high (and underwriting fees are greater). Hence, we expect a negative relation between stock market volatility and IPO volume.

H3a: Stock market volatility is negatively related to, and leads, the level of NOIPO.

The effect of stock market volatility on IPO underpricing is less clear-cut. First, according to Rock (1986) and Ritter (1984b), the greater the fundamental uncertainty of an issue, the greater the required compensation (in the form of IPO underpricing) to uninformed investors for becoming informed (Ritter 1984b, p. 220).[102] The source of the uncertainty that uninformed investors face is the uncertainty regarding the aftermarket price of an IPO (Ritter 1984b). In other words, an increase in stock market volatility increases uncertainty of the price in the aftermarket. Therefore the costs for uninformed investors to become informed rise. To compensate for these additional costs, investors require a higher expected return and hence more underpricing is observed. Therefore, a positive relationship is expected between stock market volatility and IPO underpricing.

[102] An uninformed investor can become informed by incurring a cost. The advantage of becoming an informed investor is the ability to more accurately assess the true value of a share.

An increase in stock market volatility, however, may also have a negative effect on IPO underpricing. As argued above, investors require a higher expected return in the presence of higher stock market volatility. As a result, the cost of capital also increases. Based on standard finance theory, the share price of a company is equal to the discounted stream of its expected future cash flows. With the increase in the cost of capital, the present value of any future cash flows decreases, and consequently, the share price of the company also decreases, with the effect of lower underpricing.

While the first effect implies an increase in IPO underpricing, the second effect implies a decrease in IPO underpricing. At this stage, it is unclear which effect will apply, if any. Hence, the hypothesis developed below on the relation between IPO underpricing and stock market volatility is expressed in the null form.

H3b: Stock market volatility leads the degree of IPO underpricing.

8.2.2.3 Investor Sentiment

The involvement of individual investors in the IPO market suggests that some behavioural factors may also play a role in explaining IPO underpricing.[103] Welch (1992) suggests that the IPO market is subject to 'cascades' where potential investors pay attention to the purchases of prior IPO investors and place less weight on their own information (i.e. as opposed to becoming informed at a cost).

Ritter (1991) documents that IPOs issued in hot periods exhibit poor subsequent long run performance. He reports that an investor who buys an IPO in

[103] There is evidence that the extent of the involvement of small individual investors in the stock market has changed over time (e.g. Edwards and Zhang 1998; Warther 1995).

the first day of trading would have only 83 cents for each dollar left after three years, on average (see also Menyah et al. 1995, Loughran et al. 1994, Lee et al. 1996a). Although IPOs appear to be underpriced on average, the issues seem to be overpriced from a long run perspective. An implication is that investors are consistently overoptimistic about the growth potential of companies. Krigman et al. (1999) also provide evidence that extra-hot IPOs experience the worst long-run performance compared to other IPOs.[104]

Rajan and Servaes (1995) develop a theoretical model analysing the effect of investor sentiment on the number of IPOs. They predict that companies will go public in periods when investor sentiment is high if their intent is to maximize proceeds from the issue. The empirical test of their model suggests that an increase in investor sentiment significantly increases the number of IPOs coming to market.[105] Ibbotson and Ritter (1995) also suggest that the large cycles in IPO volume represent a response by firms who time their IPOs to take advantage of swings in investor sentiment, though they do not specifically test this proposition.

Studies suggest three measures of investor sentiment, mutual fund net flows, dollar value of odd-lot purchases and sales, and discounts/premiums on closed-end funds (e.g. Neal and Wheatley 1998).[106] While Malkiel (1977) suggests that mutual fund flows reflect general investor sentiment, the results of Warther (1995) confirm this and document strong correlations between monthly stock market returns and monthly aggregate mutual fund net flows. Zweig (1973)

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[104] In Krigman et al. (1999), extra-hot IPOs are regarded as those IPOs whose first-day returns are greater than 60 percent.

[105] Note that the measures of investor sentiment used in Rajan and Servaes (1995) are questionable. Investor sentiment is measured using historical and relative market to book ratios. However, this ratio traditionally proxies for many things, such as a risk factor in the common stock returns (e.g. Lewellen 1999; Chan and Chen 1991; Fama and French 1993).

[106] Other potential investor sentiment measures include prime and score premium (see Barber 1994). However, these measures are not used here because they are available only over a short time-series.

indicates that the discount on closed-end funds is a good measure of investor sentiment and finds that changes in fund discounts predict changes in the Dow Jones Industrial Average index over the period 1966-1970. Swaminathan (1996) further examines the relationship between fund discounts and stock return using data between 1965 and 1990. He observes that discounts on closed-end funds are a good predictor of expected returns on small firms. Using data from 1928-1938, Hardy (1939) reports that the odd-lot ratio predicts movements in prices for stocks traded in the New York Stock Exchange. Neal and Wheatley (1998) test the predictive power of these measures on stock return and find that the measure of odd-lot purchases and sales provides little indication of future stock returns. As a result, we consider the measures of mutual fund net flows and discounts on closed-end funds here.

Mutual Fund Net Flows

Mutual funds operate as tax-exempt financial institutions that pool funds from many investors into a diversified asset portfolio (Remolona et al. 1997). Closed-end funds issue a fixed number of shares compared to open-end mutual funds which are obligated to redeem shares at their net asset values upon the request of investors.

The relationship between net flows of mutual funds and stock returns is well documented (e.g. Keim and Stambaugh 1986; Neal and Wheatley 1998). For instance, Warther (1995) observes that there is a correlation between mutual fund flows and market returns. Neal and Wheatley (1998) find that the ratio of net redemption to assets of mutual funds predicts stock returns, where the ratio is positively related to small firms' returns and is negatively related to large firms' returns.

Practitioners consider mutual fund flows to be a measure of investor sentiment. For instance, Malkiel (1977) suggests that mutual fund net flows reflect general investor sentiment. Remolona et al. (1997) argue that an increase in investor sentiment encourages investment in mutual funds which are reflected in net flows of mutual funds.

Based on the reports of financial analysts, Ritter (1998) suggests that there might be a positive relationship between IPO volume and net flows of mutual funds.[107] He argues that mutual funds are more willing to be involved in IPOs in periods when they have a net cash inflow. If enough fund managers are in this position in the same period, this leads to a rise in demand for IPOs due to the injection of funds into the IPO market by fund mangers. The increase in demand for IPOs might lead to over-valuations of IPOs and underpricing may consequently increase.

On the supply side, firms observe the over-valuation in the IPO market and take advantage of the over-valuation by timing their issues during these periods.

Thus, the fourth hypothesis is:

H4a: Mutual fund net flows are positively related to, and lead, the level of NOIPO.

H4b: Mutual fund net flows are positively related to, and lead, the degree of VWUP.

[107] Of note, Ritter (1998) did not test this relationship.

Discounts on Closed-end Funds

Closed-end funds are publicly traded firms which earn their income from owning and managing a portfolio of financial securities issued by other corporations and entities such as the government (Thompson 1978, p. 151). Closed-end funds are so-called because their capitalisation is fixed, or 'closed', which implies an inelastic supply of closed-end fund shares (Dimson and Kozerski 1999).

Discounts on closed-end funds are defined as the relative difference between the market value of net assets and the market value of outstanding stocks. In the case of closed-end funds, changes in investor sentiment can lead to changes in demand for closed-end fund shares that should be reflected in changes in discounts.

As discussed previously, Zweig (1973) observes that changes in fund discounts predict changes in the Dow Jones Industrial Average index over the period 1966-1970 and suggests that discounts on closed-end funds reflect the expectation of individual investors. When investor sentiment is high, investors are more willing to pay relatively more for closed-end funds leading to smaller discounts. In other words, a decrease in discounts on closed-end funds indicates an increase in investor sentiment.[108] A number of studies confirm the relationship between discounts on closed-end funds and stock returns and suggest that this relationship is more apparent for small stocks (e.g. Keim and Stambaugh 1986; Lee et al. 1991; Neal and Wheatley 1998). Moreover, Swaminathan (1996) recognises that discounts on closed-end funds can also predict future stock returns.

[108] Recall that discounts are measured as the relative difference between net asset value per share and market price of the funds.

Swaminathan (1996) also shows that high discounts predict higher than average future inflation. This suggests that the information about future expected inflation contained in the fund discounts may be indirectly related to expectations of future economic growth (p. 873). This further implies that expectations of improved economic conditions are associated with higher small firm and closed-end fund prices, and lower discounts. Issuers might want to time their issues by taking advantage of favorable economic conditions. As a result, a negative relationship is expected between discounts on closed-end funds and the number of new issues.

H5a: Discounts on closed-end funds are negatively related to, and lead, the level of NOIPO.

Firms going public, especially young and small companies, face a market that is subject to sharp swings in share valuations (Ritter 1998). In fact, many IPOs are young growth firms in specific industries, such as the high technology industries. The valuation of these new issues relies heavily on how the market values their rivals because historical accounting information of IPO firms is of limited use in forecasting future financial performance (Ritter 1998). It is suggested that discounts on closed-end funds are a predictor of the future return of small companies' shares (e.g. Swaminathan 1996). Hence, a decrease in fund discounts implies a potential upward adjustment in the valuation of small firms, including those small firms that are rivals of the IPO firms. As a result, the market valuation of IPOs will also increase leading to higher underpricing.

H5b: Discounts on closed-end funds are negatively related to, and lead, the degree of VWUP.

8.2.3 Issues Related to Lead-Lag Relationships

A weakness in previous studies of hot issue IPO markets is that they consider only the impact of current economic and stock market conditions on IPO activity. However, as discussed previously, IPO issuers cannot generally respond instantaneously to economic and market conditions since there is generally a 3-6 month period required to allow the issuers to undertake the various activities required to fulfil the legal requirements and promote the issue (Welch 1996; Lipman 1997). Therefore, firms need to generally forecast market conditions 3-6 months ahead.

This requirement increases the difficulty in identifying the appropriate length of leads and lags to examine between explanatory variables and IPO activity. The hypotheses developed above indicate the signs of the relationship between factors and IPO activities only and the direction of any lead-lag relationship. In the empirical tests that follow, up to six monthly lags (or leads) of economic and stock market variables are used to capture the delay. However, investors are expected to be able to response more quickly to the changes in economic and business conditions in their investment decisions while issuers act with a time lag during which various activities are undertaken to fulfil the legal requirements as well as the promotion of new issues. Therefore, we expect that NOIPO is explained by economic and stock market conditions with relatively longer lags, while VWUP is likely to be explained by shorter lags of economic and stock market conditions.

8.3 Data

This chapter examines the relationship between IPO activity and economic and stock market conditions in the USA. The analysis concentrates on the US sample because of the unavailability of some Australian economic data (i.e. business cycle leading indicator and industrial production). For instance, industrial production is reported quarterly rather than monthly in Australia while the analysis in this chapter requires monthly data.

Due to the similarity of the measures of US IPO volume and also in underpricing, the analysis conducted in this chapter concentrates on two IPO activity measures, NOIPO and VWUP. These series are constructed from a sample of 6,632 US IPOs listed in the USA during the period of January 1976 and June 1998.[109] The two measures are expressed on a monthly basis.

The tests of the hypotheses also require the use of economic and stock market variables, such as a business cycle indicator, a stock market index, stock market volatility and measures of investor sentiment. The section describes the collection procedure and the sources of these data. The descriptive statistics for the data are also briefly presented.

8.3.1 Business Cycle

The business cycle reflects movements in economic activity as a whole. Given the cyclical nature of the business cycle, an appropriate business cycle indicator is important in the analysis. Three business cycle indices currently popular in the USA have been developed by the National Bureau of Economic

[109] Refer to Chapter five for details.

Research. They are the leading, the coincident and the lagging composite indictors. The leading indicator (consisting of 11 variables) represents the best combination of desirable characteristics of general business activity with a forward-looking focus while the coincident and lagging indicators serve to confirm the indication of the leading indicator (Jones 1996).

It is argued above that the number of firms going public is positively associated with changes in business conditions. Further, an unexpected improvement in business conditions results in higher IPO underpricing. With consideration to the scale effect, changes in business conditions are measured as the monthly relative change in the business cycle leading indicator (*BCI*) and is calculated as:

$$BCI_t = \frac{(\text{business cycle index})_t - (\text{business cycle index})_{t-1}}{(\text{business cycle index})_{t-1}} * 100$$

8.3.2 Stock Market Level

As noted above, the stock market condition is posited to have an effect on the new issue market (e.g. Rees 1997; Loughran et al. 1994). To examine the effect of stock market conditions, a stock market index is required. Several stock market indicators are available in the USA and the most popular is the S&P 500 index. We use monthly observations of the S&P 500 index between 1976 and June 1998 that are collected from Datastream International. The monthly relative change in stock market level (*SP*) is calculated as follows:[110]

[110] Continuously compounded returns could be used, however, they would make no difference to the results.

$$SP_t = \frac{(\text{S \& P 500 index})_t - (\text{S \& P 500 index})_{t-1}}{(\text{S \& P 500 index})_{t-1}} * 100$$

8.3.3 Stock Market Volatility

Choe et al. (1993) examine the relation between stock market volatility and common stock offerings across the business cycle and measure stock market volatility by calculating it as the daily variance of stock market index returns over the 60 trading days prior to the beginning of the month of the stock offering. However, this measure may not be appropriate in this study due to the problem of overlapping periods since we use monthly data and include up to six monthly lags (or leads) of economic and stock market variables in the analysis. Instead, monthly stock market volatility (*VOL*) is used and is computed as the annualized standard deviation of daily S&P 500 index returns over the month prior to the beginning of the month of the stock offerings (expressed as a percentage). The daily S&P 500 index data is obtained from Datastream International.[111]

8.3.4 Investor Sentiment

Two measures of investor sentiment are used in the study. They are mutual fund net flows and the discount on closed-end funds.

[111] Implied volatility of options on the S&P 500 index is an alternative measure. However, these data are not available over the full sample period.

8.3.4.1 Mutual Fund Net Flows

The Investment Company Institute in the USA supplied mutual fund flow data over the period January 1984-June 1998. The mutual fund flow data between September 1975 and December 1983 was obtained from Simon Wheatley.[112]

There are two empirical issues related to the measure of mutual fund net flows. First, it is evident that there is strong growth in mutual funds over time (e.g. Remolona et al. 1997). For instance, the net assets of mutual funds in 1995 were equivalent to 60% of the assets held by commercial banks in the USA compared with only 27% in 1986. To adjust for this growth in mutual funds over time, the monthly measure of mutual fund net flows is first normalised by dividing the mutual fund net flows by the funds' net asset values for the month, following Neal and Wheatley (1998) and Remolona et al. (1997).

Second, Edelen (1999) argues that the ability of redemption by mutual fund investors forces the fund mangers to engage in liquidity-motivated trading. The decision to invest cash inflows by fund mangers (at least partly) depends on the magnitude of the cash inflows. If cash inflows in a specific month vary slightly from the expected level of inflows for the month, then fund managers may not act immediately. However, a large variation in the funds' cash position may lead fund managers to trade (Edelen 1999). This argument is empirically supported by the study of Remolona et al. (1997). In the examination of the relationship between US mutual fund flows and stock market returns, Remolona et al. (1997) find that the correlation between mutual fund net inflows and market returns can be attributed almost entirely to the unexpected component of mutual fund net inflows.

[112] The data was used in Neal, R. and S.M. Wheatley, Do Measures of Investor Sentiment Predict Returns?, *Journal of Financial and Quantitative Analysis* 33, December 1998, pp 523-547.

The implication is that an appropriate measure of mutual fund net flows is the unexpected component of mutual fund flows.

Remolona et al. (1997) calculate unexpected net flows of mutual funds by regressing mutual fund flows on three months of lags and a time trend. The residuals from the regressions serve as a measure of the unexpected mutual fund net flows. A similar approach is followed in this study. I first regress mutual fund net flows on its lags up to twelve months. Schwarz's Bayesian criterion (SBC) is used to choose the best lag model. The results favour three lags.[113] The residuals from the regression (with three months of lags) thus serve as the innovations or unexpected mutual fund net flows (*FLOW*).

8.3.4.2 Discount on Closed-end Funds

The discount on a closed-end fund is defined as the relative difference between the market value of its net assets and its outstanding stocks.

Data between 1976 and June 1998 was purchased from Wiesenberger in the USA. The series represents the monthly average percentage discount on the 50 largest US stock funds that have a trading history back to 1976. The discount on a specific closed end fund i at month t is calculated as follows:

$$Discount_{i,t} = [1 - \frac{(\text{market value of outstanding stocks})_{i,t}}{(\text{market value of net assets})_{i,t}}] * 100$$

[113] Regressions with a time trend are also examined. However, the time trend is statistically insignificant and does not improve the SBC scores.

The average percentage discount per month on the 50 largest US stock funds (*DISC*) is computed as:

$$DISC_t = \frac{\sum_{i=1}^{50} Discount_{i,t}}{50}$$

8.4 Summary Statistics

Descriptive analysis of economic and stock market variables is reported in Table 8.1. The monthly changes in the business cycle leading indicator (*BCI*) exhibits a mean value of 0.07% with a standard deviation of 0.35%. The monthly change in the S&P 500 index (*SP*) ranges from a low of -24.54% per month to a monthly high of 12.38%. The discount on closed-end funds (*DISC*) shows a mean value of 11.11% which indicates that for the largest 50 US stock funds over the period, on average, the market value of stocks is lower than the market value of their assets which is consistent with the results of Lee et al. (1991) and Neal and Wheatley (1998).[114] Although the variable of mutual fund net flows (*FLOW*) has a mean value of 0.00 and a standard deviation of 0.67, the maximum and minimum values are 3.32 and -4.87, respectively.[115] With a mean value of 12.84% (p.a. measured) per month, stock market volatility (*VOL*) is as high as 97.49% (p.a. measured) in contrast to a minimum volatility of 4.89% (p.a. measured).

[114] Recall that a decrease in discount on closed-end funds indicates an increase in investor sentiment.
[115] Recall that this variable measures unexpected mutual fund net flows.

Table 8.1: Descriptive Analysis of Economic and Stock Market Variables In the USA

	Mean	Median	Maximum	Minimum	Std. Dev.	Dickey-Fuller Test
BCI	0.065	0.099	1.375	-1.993	0.354	-6.928*
SP	0.938	1.084	12.378	-24.543	4.184	-8.254*
DISC	11.112	8.208	-1.930	39.161	9.990	-2.795^
FLOW	0.000	0.008	3.315	-4.869	0.674	-8.818*
VOL	12.842	11.579	97.489	4.890	6.907	-5.844*

1. *denotes significance at 5% level
   ^ denote significance at 10% level
2. *BCI* denotes monthly percentage change in the Business Cycle Leading Indicator;
   SP denotes monthly percentage change in the S&P 500 index;
   DISC denotes monthly percentage discounts on closed-end funds;
   FLOW denotes unexpected changes in monthly mutual fund net flows;
   VOL denotes annualised standard deviation of daily return of S&P 500 index over the month prior to the beginning of the month of stock offerings.

In the last column of Table 8.1, test statistics for the Dickey-Fuller test for a unit root process are presented. The results suggest that all the variables are stationary (though *DISC* is only significant at the 10% level).

Table 8.2 presents the monthly correlations of the economic and stock market variables. As expected, there is a significant correlation of 0.623 between *SP* and *FLOW*. This result is consistent with previous findings that there is correlation between mutual fund flows and stock market returns (e.g. Keim and Stambaugh 1986; Warther 1995; Neal and Wheatley 1998). For instance, Warther (1995) observes a correlation of 0.73 between common stock returns and unexpected mutual fund flows.

In Table 8.2, another significant correlation is observed between *BCI* and *SP*. It is well documented that changes in economic variables influence expected stock returns (e.g. Chen et al. 1986). The correlation between *BCI* and *SP* provides supportive evidence of the relationship between economic conditions and stock market returns (e.g. Moore 1961; Fama 1981; Siegel 1991).

Table 8.2: Correlation Analysis of Economic and Stock Market Variables In the USA

	SP	DISC	FLOW	VOL	BCI
DISC	-0.067	-			
	(0.275)				
FLOW	0.623	-0.161	-		
	(0.000)*	(0.008)*			
VOL	-0.048	-0.030	0.025	-	
	(0.435)	(0.622)	(0.685)		
BCI	0.196	-0.060	0.035	-0.026	-
	(0.001)*	(0.324)	(0.570)	(0.674)	

1. The Pairwise Pearson correlation analysis is used
2. Figures in parentheses are p-values for two-tailed test of the null hypothesis of zero correlation between the variables.
3. * denotes significance at 5% level.
4. *BCI* denotes monthly percentage change in the Business Cycle Leading Indicator;
   SP denotes monthly percentage change in the S&P 500 index;
   DISC denotes monthly percentage discounts on closed-end funds;
   FLOW denotes unexpected changes in monthly mutual fund net flows;
   VOL denotes annualised standard deviation of daily return of S&P 500 index over the month prior to the beginning of the month of stock offerings.

Noting that a decrease in *DISC* indicates an increase in investor sentiment. *FLOW* and *DISC* display a correlation of -0.161 which is statistically significant and implies a relationship between the two investor sentiment measures.[116]

[116] This result is consistent with Neal and Wheatley (1998). Although the correlation is somewhat lower than the correlation observed in Neal and Wheatley (1998), the measure of mutual fund flows is defined as unexpected mutual fund net flows in this study. In addition, mutual fund net flows here is calculated as a ratio of fund sales less fund redemptions to fund assets, while mutual fund flows is computed as a ratio of mutual fund redemptions less fund sales to fund assets in Neal and Wheatley (1998).

Since these three pairs of variables exhibit statistically significant correlations, multicollinearity may be presented. Multicollinearity is undesirable and can exist when the correlations among the independent variables are strong. In the presence of multicollinearity, the regression coefficients possess large standard errors relative to the coefficients themselves. Therefore, the analysis needs to take the problem of multicollinearity into account. One way to solve the problem is to avoid using the strongly correlated independent variables in the same regression.

8.5 Research Methods

The hypotheses developed in Section 8.2 are first tested using an OLS framework. With consideration of the problem of multicollinearity, three alternative models are developed

$$\textit{Model 1: } Y_t = \alpha_1 + \sum_{j=0}^{m} \beta_j BCI_{t-j} + \sum_{j=0}^{m} \chi_j Vol_{t-j} + \sum_{j=0}^{m} \delta_j Disc_{t-j} + \mu_{1,t}$$

$$\text{Model 2: } Y_t = \alpha_2 + \sum_{j=0}^{m} \phi_j BCI_{t-j} + \sum_{j=0}^{m} \varphi_j Vol_{t-j} + \sum_{j=0}^{m} \gamma_j Flow_{t-j} + \mu_{2,t}$$

$$\text{Model 3: } Y_t = \alpha_3 + \sum_{j=0}^{m} \eta_j Vol_{t-j} + \sum_{j=0}^{m} \iota_j Disc_{t-j} + \sum_{j=0}^{m} \kappa_j SP_{t-j} + \mu_{3,t}$$

Where

Y_t denotes the respective measures of IPO activity at month t, i.e. NOIPO and VWUP;

BCI_t denotes monthly percentage change in the business cycle indicator at time t;

SP_t denotes monthly percentage change in the S&P 500 index at time t,

VOL_t denotes annualised standard deviation of stock market returns over the month prior to the month of stock offerings (in percentage);

$DISC_t$ denotes average percentage discount on the 50 largest US stock funds at month t;

$FLOW_t$ denotes unexpected mutual fund net flow at month t;

m is the number of lags, m = 0, 1, 2, …,6;

$\mu_{1,t}$, $\mu_{2,t}$ and $\mu_{3,t}$ are the error terms.

The above OLS regressions examine the effects of concurrent and lagged economic and stock market variables on the level of IPO activity. However, it is also interesting to explore whether these economic and stock market variables influence the probability of hot and cold issue periods. Hence, a probit analysis is also applied.[117]

The probit model is a statistical model relating the probability of the occurrence of discrete random events that take the value of 0 or 1 (e.g. cold and hot issue periods) to some set of explanatory variables (e.g. economic and stock market variables). It yields probability estimates that the event will occur if the explanatory variables have specific values (Boulier et al. 1999). The model uses maximum likelihood and assumes that the mean of the response variable is linearly related to the explanatory variables. In our context of hot and cold issue periods, the probit model can indicate which explanatory variables influence the probability of a hot issue period.

The probit model has been used extensively in modeling dichotomous outcomes of financial data. For instance, Brailsford et al. (1995) use a probit model to test the efficiency of the Australian football betting markets, Berg et al.

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[117] An alternative to the probit model is a logit model. Amemiya (1981, p. 187) suggests that "in the univariate dichotomous model, it does not matter much whether one uses a probit or logit model, except in cases where data are heavily concentrated in the tails…". Judge et al. (1985, p. 761) also provide a theoretical argument for the use of the probit model in preference to the logit model.

(1999) and Vanova (1994) examine the predictability of financial and currency crises by applying a probit model.

For the probit model used in this study, the dependent variable is a discrete-choice variable and is defined as follows:

$$P_t = \begin{cases} 1 \text{ if an IPO activity measure suggests a hot issue period} \\ 0 \text{ if an IPO activity measure suggests a cold issue period} \end{cases}$$

where hot issue periods obtained for a specific IPO activity measure are based on the transition probabilities from the regime-switching model obtained in Chapter six (see Table 6.4).[118] The transition probabilities are used to determine the timing of regime shifts in the IPO activity measures. Recall that a hot issue period in an IPO activity measure is defined as one where at least six consecutive probabilities are greater than 0.5.

With the consideration of the problem of multicollinearity[119], three probit models are specified:

$$\text{Model 4: } P_t = b_1 + \sum_{j=0}^{m} \varpi_j BCI_{t-j} + \sum_{j=0}^{m} \theta_j Vol_{t-j} + \sum_{j=0}^{m} \vartheta_j Disc_{t-j} + \varepsilon_{1,t}$$

$$\text{Model 5: } P_t = b_2 + \sum_{j=0}^{m} \varsigma_j BCI_{t-j} + \sum_{j=0}^{m} \tau_j Vol_{t-j} + \sum_{j=0}^{m} \omega_j Flow_{t-j} + \varepsilon_{2,t}$$

$$\text{Model 6: } P_t = b_3 + \sum_{j=0}^{m} \xi_j Vol_{t-j} + \sum_{j=0}^{m} \psi_j Disc_{t-j} + \sum_{j=0}^{m} \zeta_j SP_{t-j} + \varepsilon_{3,t}$$

Where

$\varepsilon_{1,t}, \varepsilon_{2,t}$ and $\varepsilon_{3,t}$ are random disturbances.

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[118] Recall that the analysis concentrates on two IPO activity measures, NOIPO and VWUP.

[119] Refer to the discussion on the problem of multicollinearity in Section 8.4.

8.6 OLS Results

8.6.1 Regression Results for NOIPO

Table 8.3 reports OLS regression results on NOIPO, including R-squares and F-statistics. Reported t-statistics utilize the Newey-West correction for both serial correlation and heteroscedasticity. The first hypothesis is that *BCI* is positively related to, and leads, NOIPO. This hypothesis is supported by the results obtained in Models 1 and 2. They show that there is a positive relation between NOIPO and *BCI* with lags up to six months. The third lag of *BCI* is significant in Model 1 and the concurrent and the sixth lagged coefficients of *BCI* are statistically significant in both models. Compared with concurrent and other lagged *BCI* variables, the sixth lag appears to be relatively more important given its relatively larger coefficient in both models. This suggests that improvements in the expected economic conditions precede increases in the number of new issues with a lead of up to six months.

The discount on closed-end funds (*DISC*) is one of the measures of investor sentiment and is defined as the percentage average difference between net asset value per share and market price of the largest 50 US stock funds. Increased investor sentiment implies lower *DISC*. We posit that discounts on closed-end funds are negatively related to and lead the number of IPOs. Although there are mixed signs for the concurrent and lagged coefficients of *DISC*, the sixth lag *DISC* is consistently negative and statistically significant in Models 1 and 3. This implies that the effect of an increase in investor sentiment up to six months prior to the stock offering leads to an increase in number of new issues.

Table 8.3: Multivariate Regression Results for Explaining IPO Volume in the USA

	Model 1		Model 2		Model 3	
Variable	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	0.670	12.433*	0.378	5.530*	0.623	10.869*
BCI	0.110	2.203*	0.072	1.659^		
BCI Lag 1	0.036	0.865	0.019	0.470		
BCI Lag 2	0.038	0.930	0.030	0.717		
BCI Lag 3	0.104	2.821*	0.064	1.608		
BCI Lag 4	0.043	1.200	0.043	0.978		
BCI Lag 5	0.054	1.478	0.045	1.064		
BCI Lag 6	0.117	2.950*	0.131	2.997*		
VOL	-0.002	-1.017	-0.000	-0.091	-0.004	-2.070*
VOL Lag1	-0.003	-2.602*	-0.001	-0.340	-0.004	-2.931*
VOL Lag2	-0.003	-1.638	-0.002	-0.878	-0.003	-1.579
VOL Lag3	-0.001	-0.691	0.001	0.604	0.003	1.499
VOL Lag4	-0.001	-0.632	0.001	0.508	0.003	1.514
VOL Lag5	-0.000	-0.051	0.001	0.658	0.001	0.311
VOL Lag6	-0.002	-1.050	-0.003	-1.610	-0.003	-1.751^
DISC	-0.000	-0.038			0.001	0.147
DISC Lag 1	0.002	0.196			0.003	0.315
DISC Lag 2	0.005	0.663			-0.002	-0.301
DISC Lag 3	-0.003	-0.399			0.001	0.138
DISC Lag 4	-0.013	-1.566			-0.010	-1.361
DISC Lag 5	0.008	1.053			0.004	0.639
DISC Lag 6	-0.014	-1.842^			-0.012	-1.979*
SP					-0.001	-0.219
SP Lag 1					0.002	0.418
SP Lag 2					0.001	0.288
SP Lag 3					0.002	0.372
SP Lag 4					0.010	2.842*
SP Lag 5					0.014	3.598*
SP Lag 6					0.012	3.595*
FLOW			0.019	0.943		
FLOW Lag 1			0.036	1.441		
FLOW Lag 2			0.067	2.732*		
FLOW Lag 3			0.051	1.803^		
FLOW Lag 4			0.095	3.231*		
FLOW Lag 5			0.079	2.874*		
FLOW Lag 6			0.089	3.628*		
F Statistic	8.11*		4.51*		13.70*	
R-Square	0.432		0.263		0.415	

1. *denotes significance at 5% level and ^ denotes significance at 10% level.
2. t-statistics have been adjusted for both serial correlation and heteroscedasticity using Newey-West correction.
3. *BCI* denotes monthly percentage change in the Business Cycle Leading Indicator;
SP denotes monthly percentage change in the S&P 500 index;
DISC denotes monthly percentage discounts on closed-end funds;
FLOW denotes unexpected changes in monthly mutual fund net flows;
VOL denotes annualised standard deviation of daily return of the S&P 500 index over the month prior to the beginning of the month of stock offerings.

As predicted, the concurrent and lagged coefficients of mutual fund net flow (*FLOW*) are all positive. Lagged coefficients are almost all statistically significant (except the first lag) and thus indicate that the effect of mutual fund flows on NOIPO is most apparent from two to six months ahead. In other words, unexpected mutual fund net flows exhibit significant predictive ability over the current number of IPOs. The result supports our hypothesis that mutual fund net flows are positively related to and lead NOIPO.

Together with current and lagged values of stock market volatility and discounts, the effect of changes in the S&P 500 index (*SP*) on the NOIPO is examined in Model 3. Except for the coefficient on concurrent *SP*, all lagged coefficients of *SP* indicate a positive relationship with NOIPO with the last three lagged coefficients statistically significant. This supports our hypothesis.

Although Model 2 does not show any significant stock market volatility effect, the first lagged volatility parameter shows a consistently significant negative effect on NOIPO in both Models 1 and 3. This suggests that decreased stock market volatility encourages more firms to go public.

Comparing Model 3 with Model 1, where the only difference between the two models is the use of the *BCI* variable rather than the *SP* variable, Model 1 exhibits somewhat more explanatory power in terms of R-square than Model 3 though the difference in R-squares is marginal.

Of note, the F-statistics for all three models are statistically significant at the 5% level which indicates the importance of explanatory variables.

In general, the lagged effect of the explanatory variables on the NOIPO is more apparent at longer lags (e.g. lag 6). For instance, the last three lags of *SP* and the sixth lags for both *DISC* and *BCI* appear to be important in explaining NOIPO.

This result supports our argument that the various activities required to fulfill legal requirements and promote new issues forces issuers to act on forecast market conditions 3-6 months ahead.

8.6.2 *Regression Results for VWUP*

Regression results for VWUP are presented in Table 8.4. Contrary to the results for NOIPO, where we expect the economic and stock market variables to exhibit predictive power over NOIPO with lags up to 6 months, it is argued that VWUP is influenced by more recent economic and stock market conditions (see Sub-section 8.2.3).

In the first hypothesis, we posit that *BCI* is positively related to and leads IPO underpricing. For *BCI,* five out of seven coefficients are statistically significant in Model 1, while three are statistically significant in Model 2. In addition, *BCI* shows a positive relationship with VWUP up to 4 lags in both Models 1 and 2. These results support the first hypothesis that VWUP is positively related to recent economic conditions. Of note, the fifth and sixth lagged coefficients for *BCI* display a significantly negative relationship with VWUP. This result is, perhaps, a result of the cyclical nature of the variable.

Table 8.4: Multivariate Regression Results for Explaining IPO Underpricing in the USA

Variable	Model 1 Coef.	Model 1 t-stat	Model 2 Coef.	Model 2 t-stat	Model 3 Coef.	Model 3 t-stat
Constant	9.951	3.040*	8.785	2.862*	5.080	1.946^
BCI	2.698	2.002*	1.599	1.188		
BCI Lag 1	3.106	1.981*	3.031	1.561		
BCI Lag 2	3.635	2.329*	2.790	1.838^		
BCI Lag 3	1.459	1.153	1.202	0.758		
BCI Lag 4	1.945	0.930	1.519	0.683		
BCI Lag 5	-2.788	-2.301*	-2.550	-2.090*		
BCI Lag 6	-6.163	-2.529*	-5.942	-2.359*		
VOL	-0.001	-0.008	0.051	0.887	0.174	2.235*
VOL Lag1	-0.043	-1.011	-0.039	-0.757	-0.014	-0.192
VOL Lag2	0.057	0.838	0.055	0.868	0.092	1.253
VOL Lag3	0.076	1.066	0.100	1.490	0.022	0.311
VOL Lag4	0.002	0.043	0.031	0.448	-0.020	-0.353
VOL Lag5	-0.112	-1.575	-0.117	-1.628	-0.107	-1.433
VOL Lag6	-0.077	-1.695^	-0.095	-2.280*	-0.104	-1.898^
DISC	0.335	0.786			0.244	0.711
DISC Lag 1	-0.310	-0.514			-0.543	-0.913
DISC Lag 2	0.194	0.383			0.471	0.841
DISC Lag 3	-0.278	-0.459			-0.265	-0.517
DISC Lag 4	0.342	0.904			0.286	0.758
DISC Lag 5	-0.339	-0.920			-0.264	-0.752
DISC Lag 6	0.046	0.135			0.133	0.431
SP					0.453	3.775*
SP Lag 1					0.764	5.016*
SP Lag 2					0.431	3.294*
SP Lag 3					0.631	3.783*
SP Lag 4					0.321	2.542*
SP Lag 5					0.222	1.776^
SP Lag 6					-0.189	-1.637
FLOW			0.593	0.965		
FLOW Lag 1			1.407	2.041*		
FLOW Lag 2			0.403	0.446		
FLOW Lag 3			1.260	1.633		
FLOW Lag 4			0.680	0.813		
FLOW Lag 5			1.241	1.567		
FLOW Lag 6			-0.206	-0.280		
F Statistic	5.11*		6.80*		3.24*	
R-Square	0.143		0.159		0.234	

1. * denotes significance at 5% level and ^ denotes significance at 10% level.
2. t-statistics have been adjusted for both serial correlation and heteroscedasticity using Newey-west correction.
3. *BCI* denotes monthly percentage change in the Business Cycle Leading Indicator; *SP* denotes monthly percentage change in the S&P 500 index; *DISC* denotes monthly percentage discounts on closed-end funds; *FLOW* denotes unexpected changes in monthly mutual fund net flows; *VOL* denotes annualised standard deviation of daily return of the S&P 500 index over the month prior to the beginning of the month of stock offerings.

We posit that investor sentiment is positively related to and leads VWUP, but there is a lack of statistical significance of *DISC* in the models. This variable provides no statistically significant explanatory power over VWUP. However, the other investor sentiment variable, *FLOW*, does show a positive effect on VWUP with a statistically significant first lagged coefficient. In general, there appears to be a weak relation between VWUP and investor sentiment which is somewhat contradictory with regard to the results of Rajan and Servaes (1995).[120]

In the third hypothesis, we argue that there are two potential effects of different signs of stock market volatility on VWUP. The first effect, built on Rock (1986), argues that with an increase in stock market volatility, investors require a higher expected return due to the increased costs of uninformed investors becoming informed. Thus higher underpricing is required to compensate investors for higher costs. In the second effect, we argue that an increase in stock market volatility leads to an increase in the cost of capital. As a result, the discounted value of company's future cash flows decreases leading to a lower current market price. Hence, lower underpricing is expected.

The results in Table 8.4 show that the sixth lag of stock market volatility is consistently significant in all three models and displays a negative sign. Thus, it seems that there is a negative relationship between VWUP and stock market volatility. However, as discussed earlier, investors are expected to be able to respond quickly to the changes in stock market and business conditions in their investment decisions. As a result, we expect VWUP is influenced by more recent changes in the economic and stock market conditions. The significance of the sixth lagged coefficient but not at shorter lags of stock market volatility provides

[120] However, recall that investor sentiment is measured using historical and relative market to book ratios in Rajan and Servaes (1995).

only weak evidence of a relationship between VWUP and stock market volatility. However, it is noted that with the inclusion of *SP*, concurrent stock market volatility is positively related to VWUP and is statistically significant in Model 3. However, due to the insignificance of concurrent stock market volatility in both Models 1 and 2, no strong conclusion can be made.

The results obtained in Model 3 indicate that concurrent and almost all lagged coefficients of *SP* are positive and significant. This provides strong evidence that changes in the stock market level up to five months prior provide predictive power over the degree of underpricing, which supports our hypothesis. The R-square in Model 3 is the highest of the three models.

The F-statistics in all three models are significant, thus indicating the statistical importance of the explanatory variables included in the models.

Comparing the R-squares obtained in Table 8.4 with those of Table 8.3, the highest R-square in Table 8.4 is 23.4% while the lowest R-square in Table 8.3 is 26.3%. The implication is that economic and stock market variables provide more explanatory power over NOIPO than for VWUP. In other words, NOIPO appears to be more sensitive to changes in economic and stock market conditions. This may be explained by the fact that IPO underpricing is also determined by firm specific characteristics and these characteristics vary from firm to firm and from month to month. For instance, James and Wier (1990) find that the age of the firm is related to the degree of IPO underpricing. David and Yeomans (1976) observe a relationship between net assets of firms and IPO underpricing. In addition, Alli et al. (1994) show that IPOs issued by financial institutions exhibit less underpricing than IPOs of non-financial institutions.

In summary, our hypotheses are largely supported. All economic and stock market variables exhibit explanatory power over NOIPO. The lagged effect of the explanatory variables on NOIPO is more apparent at longer lags, which supports our argument that the various activities required to fulfil the legal requirements and promote new issues forces issuers to act on forecast market conditions several months ahead.

The concurrent and lagged *BCI, SP* and *FLOW* appear to explain the degree of VWUP. The insignificance of concurrent and lagged *DISC* rejects our hypothesis that *DISC* is negatively related to and leads the degree of VWUP. Although the sixth lag of stock market volatility is statistically significant in all models, there is no strong conclusion can be made regarding the relationship between stock market volatility and VWUP because we expect VWUP to be affected by more recent lags of stock market volatility. Compared to Table 8.3, the relatively lower R-squares in all models in Table 8.4 suggest that VWUP is also related to other factors, such as firm specific characteristics.

8.7 Results of Probit Analysis

This section explores the influence of the economic and stock market variables on the probability of a hot issue period occuring using probit analysis. [121]

8.7.1 Probit Analysis for NOIPO

The estimation of the probit analysis on NOIPO are presented in Table 8.5, including likelihood ratio statistics and McFadden R-squares.[122] For all models in Table 8.5, the likelihood ratio statistics strongly reject the null hypothesis that all coefficients are zero. Similar to the OLS results in Table 8.3, Model 4 consisting of concurrent and lagged values of *BCI, VOL* and *DISC* is superior to the other models (see McFadden R-squares).

Model 4 of Table 8.5 shows that the probability of a hot issue period in NOIPO increases when there is increase in *BCI* three and six months prior, a decrease in stock market volatility two months prior, and an decrease in *DISC* (or an increase in investor sentiment) six months prior.

[121] Recall that hot issue periods in NOIPO are based on the transition probabilities from the regime-switching model.

[122] The likelihood ratio statistic tests the joint null hypothesis that all coefficients except the constant are zero and is the analog of the F-statistic in the OLS regression models that test the overall significance of the model. The McFadden R-square is the likelihood ratio index and is an analog to the R-square reported in the OLS regression models. It is bounded between zero and one.

Table 8.5: Probit Results for Testing Hot Issue Periods in IPO Volume in the USA

Variable	Model 4		Model 5		Model 6	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	2.745	3.998*	1.052	1.450	2.741	3.977*
BCI	0.123	0.286	-0.095	-0.338		
BCI Lag 1	0.207	0.535	0.130	0.538		
BCI Lag 2	0.309	0.871	0.013	0.053		
BCI Lag 3	0.608	2.224*	0.351	1.391		
BCI Lag 4	0.317	1.015	0.336	1.286		
BCI Lag 5	0.173	0.579	0.200	0.816		
BCI Lag 6	0.648	2.211*	0.666	2.845*		
VOL	0.001	0.104	0.026	1.355	-0.004	-0.282
VOL Lag1	-0.034	-2.082*	-0.046	-1.612	-0.040	-2.402*
VOL Lag2	-0.030	-1.413	-0.035	-1.406	-0.039	-1.726^
VOL Lag3	-0.014	-0.917	-0.012	-0.572	-0.005	-0.432
VOL Lag4	-0.017	-0.940	-0.005	-0.261	0.006	0.422
VOL Lag5	-0.010	-0.652	-0.001	-0.036	-0.007	-0.369
VOL Lag6	-0.012	-0.881	-0.012	-0.816	-0.012	-0.951
DISC	0.020	0.330			0.027	0.371
DISC Lag 1	0.021	0.418			0.029	0.551
DISC Lag 2	0.062	1.087			0.028	0.521
DISC Lag 3	-0.003	-0.058			-0.019	-0.443
DISC Lag 4	-0.070	-1.086			-0.054	-0.835
DISC Lag 5	0.017	0.318			0.048	0.861
DISC Lag 6	-0.166	-2.565*			-0.189	-2.855*
SP					-0.013	-0.533
SP Lag 1					-0.017	-0.634
SP Lag 2					-0.009	-0.317
SP Lag 3					-0.024	-0.876
SP Lag 4					-0.012	-0.453
SP Lag 5					0.040	1.396
SP Lag 6					0.063	2.485*
FLOW			0.212	1.246		
FLOW Lag 1			0.333	2.163*		
FLOW Lag 2			0.397	2.499*		
FLOW Lag 3			0.471	3.038*		
FLOW Lag 4			0.344	2.103*		
FLOW Lag 5			0.382	2.240*		
FLOW Lag 6			0.513	3.366*		
Likelihood Ratio Statistics	170.297*		75.872*		162.168*	
McFadden R-Square	0.468		0.208		0.445	
% Correct Predictions						
Cold Issue Periods	78.51		63.64		74.38	
Hot Issue Periods	90.21		79.02		90.91	
Total	84.85		71.97		83.33	

1. * denotes significance at 5% level and ^ denotes significance at 10% level.
2. t-statistics have been adjusted for both serial correlation and heteroskedasticity using Newey-West correction.
3. Likelihood ratio statistic tests the null hypothesis that all the coefficients except the constant are zero. This is the analog of the F-statistic in linear regression models.
4. McFadden R-square is the likelihood ratio index and is an analog to the R-square reported in linear regression models.
5. % correct predictions are based on the cutoff probability of 0.5. Observations are classified as having predicted probabilities that are above of below the cutoff value. For instance, 'correct' classifications for cold issue periods are obtained when the predicted probability is less than or equal to 0.5.
6. *BCI* denotes monthly percentage change in the Business Cycle Leading Indicator; *SP* denotes monthly percentage change in the S&P 500 index; *DISC* denotes monthly percentage discounts on closed-end funds; *FLOW* denotes unexpected changes in monthly mutual fund net flows; *VOL* denotes annualised standard deviation of daily return of the S&P 500 index over the month prior to the beginning of the month of stock offerings.

Replacing *DISC* with *FLOW* in Model 5, all lagged coefficients of *FLOW* exhibit statistical significance. This indicates that rises in unexpected mutual fund net flow in the previous six months increase the probability of NOIPO in hot issue periods. The implication is that investment from mutual funds is an important driving force for hot issue periods in NOIPO. However, it is noted that the McFadden R-square for this model is relatively low when compared with Models 4 and 6.

Model 6 in Table 8.5 estimates the influence of concurrent and lagged changes in the S&P 500 on the probability of hot issue periods in NOIPO as well the influence of *BCI* and stock market volatility. The results suggest that an increase in the stock market level six months prior, decreased stock market volatility in the previous two months, as well as decreased discounts six months prior, have explanatory power over the probability of a hot period in NOIPO.

The probit results presented in Table 8.5 indicate that all economic and stock market variables, as well as the measures of investor sentiment, exhibit explanatory power for the probability of hot issue periods in NOIPO. Hence, all our hypotheses regarding the influence of the economic and stock market conditions, as well as investor sentiment, on IPO volume are supported.

Comparing the size of the coefficients on the lags, again, the sixth lagged coefficient of all variables (except stock market volatility) is the largest. This implies that an improvement in economic and stock market conditions six months prior has an important influence on the probability of a hot issue period in NOIPO, which is consistent with the OLS results obtained in Table 8.3. Both OLS and probit analysis present similar results for all economic and stock market variables.

The last three rows in Table 8.5 report the percentage of correct predictions for the three probit models over whether the NOIPO will be in hot and cold issue periods. The cutoff probability is specified as 0.5.[123] Observations are classified as having predicted probabilities that are above or below the cutoff value of 0.5. That is, 'correct' classifications for hot issue periods are obtained when the predicted probability is more than 0.5, while 'correct' classifications for cold issue periods are obtained when the predicted probability is less than 0.5. The results reveal that the three probit models are more accurate than a naïve model in their prediction of the hot and cold states for the NOIPO. Moreover, the models predict hot issue periods more correctly than they predict cold issue periods. The correct prediction for hot periods ranges from 79.02% to 90.91% while the correct prediction for cold periods is between 63.64% and 78.51%. Overall, Model 4 generates the highest average correct prediction (84.85%) for both hot and cold periods.

8.7.2 Probit Analysis for VWUP

The results of the probit analysis on underpricing are reported in Table 8.6. The likelihood ratio statistics in all models reject the null hypothesis that all coefficients are jointly zero. While the probit estimation on NOIPO exhibited relatively higher McFadden R-squares than the equivalent OLS results, the three probit models for VWUP exhibit McFadden R-squares of around 11%.

[123] Note that the specified cutoff probability of 0.5 is consistent with the rules I used in the regime switching estimations.

Table 8.6: Probit Results for Testing Hot Issue Periods in IPO Underpricing in the USA

Variable	Model 4		Model 5		Model 6	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constant	0.838	1.427	0.635	0.806	0.525	1.033
BCI	0.519	2.404*	0.358	1.608		
BCI Lag 1	0.463	2.115*	0.313	1.441		
BCI Lag 2	0.550	2.417*	0.466	2.274*		
BCI Lag 3	0.523	2.411*	0.495	2.251*		
BCI Lag 4	0.315	1.658^	0.329	1.730^		
BCI Lag 5	-0.044	-0.201	-0.054	-0.338		
BCI Lag 6	0.007	0.023	0.032	0.137		
VOL	-0.021	-1.201	-0.022	-0.979	-0.027	-1.111
VOL Lag1	-0.009	-0.973	-0.007	-0.501	-0.010	-0.494
VOL Lag2	-0.005	-0.547	0.002	0.156	0.002	0.135
VOL Lag3	0.006	0.671	0.005	0.541	0.011	0.766
VOL Lag4	-0.008	-0.897	-0.008	-0.900	-0.006	-0.452
VOL Lag5	-0.016	-1.214	-0.016	-1.382	-0.016	-1.366
VOL Lag6	-0.027	-1.323	-0.025	-1.004	-0.024	-1.398
DISC	0.007	0.125			-0.014	-0.259
DISC Lag 1	0.059	1.491			0.057	1.274
DISC Lag 2	-0.007	-0.178			-0.007	-0.149
DISC Lag 3	-0.008	-0.213			-0.000	-0.003
DISC Lag 4	-0.033	-0.853			-0.035	-0.876
DISC Lag 5	0.017	0.509			0.010	0.260
DISC Lag 6	-0.044	-0.894			-0.015	-0.316
SP					0.027	1.438
SP Lag 1					0.045	1.952^
SP Lag 2					0.053	2.336*
SP Lag 3					0.065	2.743*
SP Lag 4					0.049	1.948^
SP Lag 5					0.029	1.186
SP Lag 6					0.007	0.304
FLOW			0.168	1.483		
FLOW Lag 1			0.195	1.339		
FLOW Lag 2			0.198	1.275		
FLOW Lag 3			0.199	1.340		
FLOW Lag 4			0.120	0.852		
FLOW Lag 5			0.043	0.327		
FLOW Lag 6			0.025	0.191		
Likelihood Ratio Statistics	40.980*		42.447*		37.089*	
McFadden R-Square	0.113		0.117		0.102	
% Correct Predictions						
Cold Issue Periods	63.45		71.72		69.66	
Hot Issue Periods	58.82		53.78		59.66	
Total	61.36		63.64		65.15	

1. * denotes significance at 5% level and ^ denotes significance at 10% level.

2. t-statistics have been adjusted for both serial correlation and heteroskedasticity using Newey-West correction.

3. Likelihood ratio statistic tests the null hypothesis that all the coefficients except the constant are zero. This is the analog of the F-statistic in linear regression models.

4. McFadden R-square is the likelihood ratio index and is an analog to the R-square reported in linear regression models.

5. % correct predictions are based on the cutoff probability of 0.5. Observations are classified as having predicted probabilities that are above of below the cutoff value. For instance, 'correct' classifications for cold issue periods are obtained when the predicted probability is less than or equal to 0.5.

6. *BCI* denotes monthly percentage change in the Business Cycle Leading Indicator; *SP* denotes monthly percentage change in the S&P 500 index; *DISC* denotes monthly percentage discounts on closed-end funds; *FLOW* denotes unexpected changes in monthly mutual fund net flows; *VOL* denotes annualised standard deviation of daily return of the S&P 500 index over the month prior to the beginning of the month of stock offerings.

We expect concurrent and lagged *BCI* to positively influence the probability of hot issue periods in VWUP, and the results provide strong support with the second, third, and fourth lagged coefficients for *BCI* consistently positive and significant.

The first five lags of *SP* are positive and significant in Model 6. This indicates that the higher the stock market level in the last five months, the higher the probability that VWUP will enter a hot issue period. This is consistent with our earlier hypothesis.

There is a lack of significance in the concurrent and lagged values of stock market volatiility, discounts on closed-end funds and mutual fund net flows in Table 8.6. While the second lagged coefficient of *FLOW* displays explanatory power over the degree of VWUP in the OLS analysis, *FLOW* is not significantly related to the probability of hot issue periods in VWUP in Table 8.6. The probit analysis suggests that neither investor sentiment or stock market volatility has a significant influence on the probability of hot issue periods in VWUP. Rather, the hot issue periods in VWUP appear to be driven by only upturns in the stock market level in the prior five months and improvement in economic conditions in the prior four months.

Although only *BCI* and *SP* appear to have significantly explanatory power over the probability of hot issue periods in VWUP, the likelihood ratio statistics in all models are statistically significant and the percentage correct prediction of the three models on hot and cold periods of VWUP still exceeds 60%.

8.8 Summary and Conclusion

In this chapter, several hypotheses are developed by considering both demand and supply factors in order to explore the underlying causes of hot issue IPO markets. The hypotheses are tested using both OLS and probit analyses.

In summary, our hypotheses are largely supported. Based on the OLS results, all economic and stock market variables exhibit explanatory power over the number of firms going public. For VWUP, the concurrent and lagged *BCI*, *SP* and *FLOW* exhibit statistical importance in explaining VWUP. However, two variables, *DISC* and *VOL*, do not appear to explain IPO underpricing. Compared to the regression results on NOIPO in Table 8.3, the regression analysis for VWUP shows relatively lower R-squares in all models (see Table 8.4). I argue that this may occur because IPO underpricing is also related to the firm specific characteristics.

The probit analysis exhibits similar results. All economic and stock market variables appear to influence the probability of hot issue periods in NOIPO. Based on the percentage of correct predictions of whether NOIPO will be in hot or cold periods, all three probit models display a high level of accuracy. Although hot issue periods in VWUP appear to be driven only by changes in the stock market level and business cycle leading indicator, the correct prediction of the three probit models on VWUP still exceeds 60%.

Finally, both the OLS and probit results suggest that the effect of economic and stock market factors on NOIPO is more apparent at longer lags in comparison with the results of VWUP. This supports the argument that the various activities required to fulfil the legal requirements and promote new issues force issuers to act on expected market conditions around 3-6 months ahead.

CHAPTER NINE

THE INTERRELATIONSHIP BETWEEN THE US AND AUSTRALIAN IPO MARKETS

9.1 Introduction

There has been considerable growth in the flow of international investment across markets in recent years. For instance, equity investment flows across markets increased from US$2.86 billion in 1990 to US$15.51 billion in 1998.[124] This is in part due to the change in global political and economic dynamics which occurred during the 1980s. For instance, the collapse of the Berlin Wall and the resurrection of a social market economy for some Eastern European countries and China. Further, many South American governments privatised state-owned enterprises following the practice of the United Kingdom. The demand for international equity capital has increased and emerging markets now represent a feasible investment alternative for international investors (Bilson, Brailsford and Hooper 1999). In addition, the relaxation of controls on capital movements, globalisation and improvements in technology have also stimulated international fund flows. For instance, improved telecommunication technology allows information and capital to flow relatively unimpeded across international boundaries, enhancing market efficiency (Arshanapalli and Doukas 1993). The growth in international flow of capital, in turn, has motivated interaction between

[124] Source: Table 7.6: Global Financial Flow, *World Development Indicator 2000*, World Bank.

stock markets. In other words, existing linkages between world equity markets have been improved and a significant market disturbance in one country can be more easily transmitted to other stock exchanges (Jeon and Furstenberg 1990).

The increasing interaction among national stock markets should, in turn, lead to an increasing correlation among IPO activity across markets. The results obtained in Chapters six and seven confirm the existence of hot issue periods in both the Australia and the USA. Moreover, IPO activity is related to economic and stock market activities. The US market is the most influential market in the world where movements in the US stock market influence the behaviour of other stock markets (Eun and Shim 1989; Janakiramanan and Lamba 1998; Brocato 1990). This suggests that, *prima facie*, aggregate US IPO activity should also influence IPO activity in other markets.

Indeed, previous research has indirectly documented the interrelationship between international IPO markets. In addition to the previously documented hot markets in the early and mid-1980s in the USA (see Ritter 1984b; Ibbotson et al. 1994), hot issue IPO markets have also been documented in other markets, including the UK and South Korea in the late 1980s and Germany during 1982-1983 and 1985-1986 (Ibbotson and Ritter 1995; Ritter 1998). Moreover, Loughran et al. (1994) study fifteen international IPO markets and find evidence of a positive correlation between IPO volume and the level of the stock market in 14 out of 15 countries. The results imply that the relationship between international IPO markets may exist.

In an environment where international interaction is significant, knowledge of the relationship among international IPO markets is important for at least three reasons. First, individual investors are interested in the relationships between the national IPO markets for diversification purposes. An analysis of the interrelationship between the international IPO activities may shed additional light on the issue of international diversification. Second, owners and financial managers of private companies are also interested in worldwide IPO activity as it may influences investment decision. For instance, if US IPO activity leads Australian IPO activity, Australian financial managers who observe a hot issue period in the USA may take this as a signal that they can bring an IPO to the Australian market under favourable conditions. Third, an understanding of financial linkages in international IPO activity can also be useful for policy coordination across governments and stock exchanges.

However, there exists no in-depth analysis of the interdependence among national IPO markets. Loughran et al. (1994) document evidence of the short-run and long run performance of IPOs in fifteen countries but do not further examine the interrelationship between these markets. This may be due to the relatively short time period of their data. This chapter aims to fill this gap in the literature by analysing the lead-lag relationship in the IPO markets using Australian and US IPO data.

The purpose of this chapter is to provide evidence of the interrelationship between the US and Australian IPO markets. Specifically, this chapter addresses the following issues:

a) Does the US IPO market activity influence Australian IPO market activity? In turn, does Australian IPO market activity influence the US IPO market activity?

b) Is there one market whose movements in IPO activity lead activity in another country?

c) How rapidly are the movements of IPO activity in one country transmitted to another country, if at all?

In attempting to answer the above questions, a Vector Autoregressive analysis (VAR) is applied to all monthly measures of IPO activity developed in Chapter four for both the USA and Australia during the period January 1976 to June 1997. The analysis incorporates the role of stock market conditions in the markets and allows for the possibility of a lead-lag interaction between the markets.

9.2 Review of Stock Market Linkages

Financial linkages among world stock markets have attracted much attention. The initial work of Grubel (1968) documents the benefits of international portfolio diversification. Using pre-1980 data, a number of studies examine the lead-lag relationships in national stock market indices (e.g. Granger and Morgenstern 1970; Agmon 1972; Hilliard 1979; Schneeweis and Hill 1980). Generally, their studies find that movements of stock returns in different countries are unrelated to each other and hence a reduction in risk can be obtained by diversifying a portfolio internationally.

In contrast, recent research using post-1980 data shows that there exists a substantial degree of interdependence among national stock markets (e.g. Eun and Shim 1989; Brocato 1990; Jeon and Furstenberg 1990). Brocato (1990) analyses the financial linkages among six major stock exchanges (the USA, Canada, Great Britain, Japan, Germany and Hong Kong) and shows that movements in the US stock market return are a major influence over the behaviour of other stock markets. Janakiramanan and Lamba (1998) examine the financial linkages in stock market indices between Pacific-Basin and the US stock markets during 1988-1996. Their results show that in general, the US stock market affects all Australasian stock markets. Using the data of nine national stock markets between 1980 and 1985, Eun and Shim (1989) recognise that the US market is the most influential in the world. Innovations in the US market are rapidly transmitted to other markets whereas no other single market can significantly explain US market movements.

The interaction among national stock markets can also be characterised by examining the volatilities of stock prices in different markets. Using high-frequency data surrounding the 1987 stock market crash, King and Wadhwani (1990) and Bertero and Mayer (1990) found that international correlations in price movements tend to increase during a stock market crisis. In other words, higher volatility in one market may lead to increased correlation between price movements in that market and other markets. Using monthly excess returns for seven major countries over the period 1960-1990, Longin and Solnik (1995) analyse the correlation in international stock returns and find that the correlation rises in periods when market volatility is high. Arshanapalli and Doukas (1993) study the linkage between European and the US markets before and after the 1987 stock market crash. They find that the European stock markets are strongly linked with the US market for the post-1987 stock market crash period while weaker linkages are observed for the pre-crash period.

More recently, Hamao et al. (1990) examine the spillover of conditional return means and variances across the UK, the USA and Japan by applying

GARCH models on daily returns. They find spillover effects for the conditional variances from the USA and the UK to Japan, but not vice versa. In a related study, Brailsford (1996) finds bi-directional spillovers between the Australian and New Zealand stock markets. Through an investigation of volatility spillover between the US and various Asian markets, Ng et al. (1991) show that volatility spillovers exist across Asian markets but only in periods when international investment restrictions have been relaxed.

Beyond measuring the extent of integration in stock exchanges, several studies investigate whether the financial linkages among national stock price indexes are stable over time. However, the results are mixed. While Philippatos et al. (1983) support the existence of inter-temporal stability of international stock market relationships using monthly returns for fourteen countries from 1959 to 1978, Kaplanis (1988) suggests the stability in the monthly stock return correlations of ten markets over 1967-1982. In contrast, Koch and Koch (1991) examine the correlation across national stock indices of eight markets using daily data for three separate years (1972, 1980 and 1987) and conclude that international stock markets have grown more interdependent recently. Von Furstenberg and Jeon (1989) reach a similar conclusion based on Vector Autoregressive results of four markets over 1986-1988. Further, Longin and Solnik (1995) examine the monthly excess return for seven major countries over the period 1960-1990 and find that the international covariance and correlation matrices of stock returns are unstable over time.

Recently, research on the financial linkages between stock exchanges has been extended to examine national business conditions and national stock market returns. Erb et al. (1994) find that the correlation between the stock markets of the

G-7 countries is higher when both countries are in a contractionary phase. Further, Ragunathan, Faff and Brooks (1999) examine the correlation between Australia and the US national stock market returns over the business cycle and also conclude that the correlations between the two markets are higher when the US economy is in a contractionary phase.

In summary, research suggests that international stock markets have grown more interdependent, especially after the 1987 stock market crash. US stock market returns are the major influence on the stock return movements of other markets. Moreover, the correlation between national stock market returns varies over time and appears related to economic conditions.

9.3 Development of Hypotheses

In the literature, there are several reasons advanced as to why stock returns are correlated across markets. First, Janakiramanan and Lamba (1998) suggest that the financial dominance of the US market is partly due to its dominant economic power. In the post-World War II period, the status of the most influential world economy shifted from Britain to the USA. Since the US dollar dominates most of the cross-border trading, economic factors affecting the US capital market will be reflected in the US currency.

Second, Lin et al. (1994) suggest that if two economies are associated through international trade and investment, any news about economic fundamentals in one country is likely to have implications for the other country. Further, Janakiramanan and Lamba (1998) claim that the market that is larger in size is more likely to influence the smaller market.

Third, Longin and Solnik (1995) argue that the progressive removal of impediments to international investment, as well as the growing political and financial integration, lead to an increase in international correlation across financial markets (see also Rogers 1994). Further, Bilson, Brailsford and Hooper (1999) suggest that "barriers to integration are either macro-economic or stock market specific. Macro-economic instability can be due to poor credit rating, high inflation, exchange control, economic policy risk, liquidity risk and currency risk. Stock market specific barriers are influenced by the degree to which the market is developed in terms of the presence of international brokers, market size, regulation and accounting system" (p. 3). Removal of these barriers will lead to greater integration across markets.

The Australian financial market has undergone major changes over the last decade and experienced significant financial deregulation. For instance, the floating of the Australian dollar in 1983, the admittance of full banking operations for foreign banks, the introduction of discount brokerage services, decreases in commission rates and the relaxation of foreign controls in the stockbroking business occurred in the 1980s (Bruce et al. 1991). Further, the Australian Stock Exchange Limited was amalgamated through the six stock exchanges in Australia in 1987. It also automated its trading system through the Stock Exchange Automated Trading System (SEATS).

Traditionally, direct trading with the USA plays an important role in the Australian economy. Based on information from the Australian Bureau of Statistics, direct trading between the USA and Australia increased from A$17,266 million in 1991 to A$28,875 million in 1999. Moreover, direct exports and imports between Australia and the USA account for 9.28% and 21.40% of total

Australian exports and imports in 1999, respectively.[125] These figures reveal an important linkage between the two countries. Since the US market is more dominant and is larger in size, it is reasonable to expect that movements in the US stock market affect movements in the Australian stock market. In fact, Eun and Shim (1989) and Janakiramanan and Lamba (1998) provide empirical evidence of US stock market influences over the Australian stock market. Therefore, it is reasonable to expect that there may also be a linkage in aggregate IPO activity between Australia and the USA such that US IPO activity leads Australian IPO activity.

In this thesis, the level of IPO activity has been examined through two broad activity measures being IPO volume and underpricing. I first discuss the relationship in IPO volume between the two markets. Since changes in the stock price reflect a change in investor expectations about future business conditions, a higher stock market return reflects an upward revision in investor expectations (Choe et al. 1993). It has also been argued in Chapter eight that the offer price for an IPO is normally set based on the expected business conditions at the date of price setting. Subsequently, higher underpricing is expected if there is an upward revision in expected future business conditions. As a result, there should be a positive relation between stock market returns and IPO underpricing, as argued previously. Indeed, the results obtained in Chapter eight confirm this relationship (see Table 8.4).

As described in Section 9.2, the literature suggests that US stock market movements are the major influence on movements of other markets (e.g. Eun and

[125]Source: *Australia Now – A Statistical Profile*, Australian Bureau of Statistics, 1999, Canberra, Australia.

Shim 1989; Brocato 1990). The implication is that US stock market returns lead Australian stock market returns.

Combining the discussions above, an improvement in the US stock market condition will result in two consequences. First, an improvement in the US stock market will lead to higher underpricing in the local IPO market due to the evidence of a positive relation between stock market conditions and IPO underpricing (see Chapter eight). Second, an improvement in the US stock market will transmit to the Australian stock market, which leads to a subsequent improvement in the Australian stock market condition. The improvement in the Australian stock market should, in turn, also result in higher IPO underpricing in the Australian IPO market. Therefore, it is reasonable to expect that US IPO underpricing leads IPO underpricing in Australia.

Two critical issues need to be considered in considering the financial linkage in IPO underpricing between Australia and the USA. First, the industry concentration of the two markets differs. For instance, natural resource IPOs account for 31.85% of total IPOs during January 1976-June 1997 in Australia while natural resource IPOs represent only 2.73% of total offerings in the USA between January 1976 and June 1998 (see Chapter four).[126] The results obtained in Chapters five and seven suggest that while the volume of Australian resource issues follows the general trend in the market, resource sector IPOs exhibit different underpricing behaviour in comparison to their industrial counterparts. Specifically, underpricing in resource sector IPOs tends to be higher and unpredictable.

[126] Note that average underpricing for natural resource IPOs is generally above the average underpricing of all IPOs.

Second, the empirical results obtained in Chapter eight suggest that the degree of IPO underpricing may be affected by many factors. In addition to economic and stock market conditions, the degree of IPO underpricing may also be related to company specific factors, such as the size of issues (e.g. Michaely and Shaw 1994; Maksimovic and Unal 1993), price of issues (e.g. Jain 1995; Chalk and Peavy 1987), industry classification of issues (e.g. Ritter 1984b; How et al. 1995), underwriters (e.g. Johnson and Miller 1988; Carter et al. 1998), ages and sizes of the firms (e.g. James and Wier 1990; Davis and Yeomans 1976), and ownership structures of the firms (e.g. Leland and Pyle 1977; Downes and Heinkel 1992).[127] Chapters five and eight show that resource sector IPOs tend to be smaller in size and greater in underpricing.

Since companies going public in two different markets are unlikely to be identical in every respect, the degree of aggregate IPO underpricing may therefore differ between the two markets. Moreover, the results obtained in Chapter seven indicate that resource sector IPOs exhibit a substantial influence on the price measures of total IPO market activity in Australia. As a result, it is expected that the linkage in IPO underpricing between the two countries will be presented but weaker than first expected. The first hypothesis is therefore:

H1: there is a (weak) linkage in monthly IPO underpricing between Australia and the USA, whereby US IPO underpricing leads Australian IPO underpricing.

[127] Refer to Chapter two for full details.

In Chapters six and seven, a lead-lag relationship between IPO underpricing and volume was observed for both the USA and Australia, whereby IPO underpricing leads volume by up to six months.[128] Since US IPO underpricing is expected to lead Australian IPO underpricing, as argued above, evidence of the leading effect of IPO underpricing on volume in local markets suggests that there should be a linkage in IPO volume between the two markets, whereby US IPO volume leads Australian IPO volume. Therefore, we posit that there is a lead-lag relationship between the US and Australian IPO volume. The second hypothesis is

H2: there is a linkage in monthly IPO volume between Australia and the USA, whereby US IPO volume leads Australian IPO volume.

Unlike an instantaneous lead-lag relationship in international stock market returns (i.e. within 24 hours, Bracker et al. 1999), the lead-lag relationship in monthly IPO volume between the two countries will take longer. This is because IPO issuers in one country cannot generally respond instantaneously to favourable IPO market conditions in another market since there is a 3-6 month period needed to undertake the various activities required to fulfil the legal requirements and promote the issue (Welch 1996; Lipman 1997).[129] However, investors are expected to be able to respond more quickly to the changes in the IPO and stock market conditions. As a result, the lead-lag relationship in IPO underpricing between Australia and the USA is expected to exhibit at a shorter lag.

[128] Note that this lead-lag relationship between IPO underpricing and volume is not evident in the Australian resource sector IPOs.
[129] Refer to earlier discussion.

9.4 Data and Research Method

9.4.1 Data

This chapter examines the interrelationship in the aggregate IPO market activity between Australia and the USA. The level of IPO activity between the two countries is examined through two broad measures being IPO volume and underpricing. Consistent with earlier chapters, the four variables developed in Chapter five that measure these aspects of IPO activity are used. While NOIPO and GP concern volume, VWUP and VUP concern underpricing. Each variable is measured on a monthly basis over the period January 1976 – June 1997.[130]

The variables used in the analysis are described below:

USNOIPO = NOIPO for the US IPO sample;

AUSNOIPO = NOIPO for the Australian IPO sample;

USGP= GP for the US IPO sample;

AUSGP= GP for Australian IPO sample;

USVWUP= VWUP for the US IPO sample;

AUSVWUP= VWUP for the Australian IPO sample;

USVUP= VUP for the US IPO sample;

AUSVUP= VUP for the Australian IPO sample;

Details of the variable construction and summary statistics for the variables are provided in Chapter five.

[130] Refer to Chapter five for details.

9.4.2 *Research Method*

The method used to examine the interrelationship in the level of aggregate IPO market activity between the two countries involves the use of a Vector Autoregression (VAR) model. The method requires stationarity in each time series. Based on the results of Dickey-Fuller tests reported in Tables 5.1 and 5.4, the IPO activity measures used here are all stationary.

The results obtained in Chapter eight indicate that stock market and business cycle variables have explanatory power in explaining both measures of IPO underpricing and volume. The implication is straightforward, that is, the VAR analysis needs to incorporate the role of economic and stock market variables as control variables to avoid model mis-specification. Since a business cycle leading indicator is not readily available in Australia, only relative changes in the stock market indices can be considered. Hence, relative changes in the monthly stock market indices for both Australia and the USA are incorporated in the VAR analysis. The Australian stock market index used is the All Ordinaries Price Index and is obtained from Datastream International. The US stock market index used is the S&P 500 index and has been discussed in Chapter eight.[131]

The form of the VAR becomes:

$$y_{1,t} = a_1 + \sum_{i=1}^{m} \beta_{1,i} y_{1,t-i} + \sum_{i=1}^{m} \delta_{1,i} y_{2,t-i} + \sum_{i=1}^{m} \phi_{1,i} USSP_{t-i} + \sum_{i=1}^{m} \varphi_{1,i} AUSSP_{t-i} + \mu_{1,t}$$

$$y_{2,t} = a_2 + \sum_{i=1}^{m} \beta_{2,i} y_{2,t-i} + \sum_{i=1}^{m} \delta_{2,i} y_{2,t-i} + \sum_{i=1}^{m} \phi_{2,i} USSP_{t-i} + \sum_{i=1}^{m} \varphi_{2,i} AUSSP_{t-i} + \mu_{2,t}$$

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[131] Instead of the relative change in both US and Australian stock market indices, the monthly change in the Morgan Staney Capital International Index was also used. The results from this alternative index indicate that the conclusions remain unchanged.

where

$y_{1,t}$ denotes the measure of IPO activity in the USA at month t;

$y_{2,t}$ denotes the measure of IPO activity in Australia at month t;

m is the number of lags;

$USSP_t$ is the relative changes in the S&P 500 index at month t;

$AUSSP_t$ is the relative changes in the All Ordinaries price index at month t;

$\mu_{1,t}$ and $\mu_{2,t}$ are the error terms.

Several critical issues are relevant in the VAR analysis. First, we need to decide how many lags should be included in the model. Given degrees of freedom considerations, as well as the regulatory and institutional features in an IPO market where issuers cannot respond instantaneously to market conditions (due to a three- to six-month lag during which time various activities are undertaken to fulfil the legal requirement and promotion of issues), a lag length of six months for the VAR analysis is chosen.[132]

Second, there is evidence of heteroscedasticity in some series. For instance, Figures 9.1a and 9.1b provide correlograms of the residuals and squared residuals for the analysis on AUSNOIPO. In Figure 9.1b, the Q statistics test for changes in variance across time using lag windows ranging from 1 through 12. The p-values for the test statistics reported in the last column indicate heteroscedasticity. Therefore, a Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model is used to model the series with heteroscedastic errors.

[132] The choice of lag length of six months is somewhat arbitrary. However, this lag length is logical and consistent with earlier arguments.

Figure 9.1a: An Example Correlogram of Residuals

$$AUSNOIPO_t = a_1 + \sum_{i=1}^{6} \beta_i USNOIPO_{t-i} + \sum_{i=1}^{6} \delta_i AUSNOIPO_{t-i} + \sum_{i=1}^{6} \theta_i AUSSP_{t-i} + \sum_{i=1}^{6} \varphi_i USSP_{t-i} + \mu_t$$

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|. |	.|. |	1	-0.003	-0.003	0.0029	0.957
.|. |	.|. |	2	-0.015	-0.015	0.0595	0.971
.|. |	.|. |	3	-0.024	-0.024	0.2099	0.976
.|. |	.|. |	4	-0.004	-0.004	0.2138	0.995
.|. |	.|. |	5	-0.019	-0.020	0.3083	0.997
*|. |	*|. |	6	-0.064	-0.065	1.3892	0.967
*|. |	*|. |	7	-0.073	-0.075	2.7772	0.905
.|. |	.|. |	8	0.023	0.019	2.9106	0.940
.|. |	.|. |	9	0.032	0.027	3.1849	0.957
.|. |	.|. |	10	0.016	0.013	3.2541	0.975
.|. |	.|. |	11	-0.015	-0.016	3.3123	0.986
.|* |	.|* |	12	0.150	0.147	9.3174	0.676

Figure 9.1b: An Example Correlogram of Squared Residuals

$$AUSNOIPO_t = a_1 + \sum_{i=1}^{6} \beta_i USNOIPO_{t-i} + \sum_{i=1}^{6} \delta_i AUSNOIPO_{t-i} + \sum_{i=1}^{6} \theta_i AUSSP_{t-i} + \sum_{i=1}^{6} \varphi_i USSP_{t-i} + \mu_t$$

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|** |	.|** |	1	0.318	0.318	25.77*	0.000
.|** |	.|** |	2	0.325	0.250	52.89*	0.000
.|*** |	.|** |	3	0.389	0.275	91.76*	0.000
.|** |	.|* |	4	0.297	0.108	114.56*	0.000
.|* |	*|. |	5	0.150	-0.096	120.37*	0.000
.|* |	*|. |	6	0.149	-0.058	126.16*	0.000
.|* |	.|. |	7	0.114	-0.036	129.55*	0.000
.|* |	.|. |	8	0.119	0.062	133.25*	0.000
.|. |	.|. |	9	0.046	-0.012	133.81*	0.000
.|. |	.|. |	10	0.014	-0.050	133.86*	0.000
.|. |	.|. |	11	0.036	-0.006	134.21*	0.000
.|. |	.|. |	12	0.052	0.047	134.94*	0.000

Note:

1. This is only an example to show the evidence of heteroscedasticity in the models (before an IGARCH process). The correlograms for other models are available upon request.
2. * denotes significance at 5% level.

A GARCH (1,1) process was initially fitted to the data. However, the initial estimates indicated an explosive process in the unconditional variance with the GARCH parameters summing to a number slightly greater than one. Therefore, restrictions are imposed through an integrated GARCH process (IGARCH) when appropriate.[133]

As a result, the final form of VAR analysis is:

$$y_{1,t} = a_1 + \sum_{i=1}^{6} \beta_{1,i} y_{1,t-i} + \sum_{i=1}^{6} \delta_{1,i} y_{2,t-i} + \sum_{i=1}^{6} \phi_{1,i} USSP_{t-i} + \sum_{i=1}^{6} \varphi_{1,i} AUSSP_{t-i} + \mu_{1,t}$$

$$y_{2,t} = a_2 + \sum_{i=1}^{6} \beta_{2,i} y_{2,t-i} + \sum_{i=1}^{6} \delta_{2,i} y_{2,t-i} + \sum_{i=1}^{6} \phi_{2,i} USSP_{t-i} + \sum_{i=1}^{6} \varphi_{2,i} AUSSP_{t-i} + \mu_{2,t}$$

$\mu_{1,t}$, and $\mu_{2,t}$ ~N$(0, h_t^2)$

$$h_t^2 = v + f_1 \mu_{t-1}^2 + f_2 h_{t-1}^2 .$$

where

h_t^2 is the conditional variance and is a function of three terms:

- the mean, v;
- innovations from the previous month, measured as the lag of the squared residual from the VAR equation, μ_{t-1}^2;
- last month's forecasted variance, h_{t-1}^2.

$f_1 + f_2 = 1$.

[133] The IGARCH process imposes constraint on the GARCH parameters where the GARCH parameters sum to 1.

9.5 Empirical Results

9.5.1 IPO Volume

The results of the VAR analysis are reported in Table 9.1. The VAR models enable a test of the predictability of lagged USNOIPO on AUSNOIPO and vice versa. For USNOIPO, the table shows that the lagged coefficients of USNOIPO up to 3 months are positive and significant. This finding is consistent with the autocorrelation results reported in Table 5.1, and suggests that lags up to three months exhibit significant predictive ability over the current level of USNOIPO. The first three lagged coefficients of USNOIPO add up to a value of 0.842 which indicates that over 80% of current variation of the number of US IPOs is explained by its first three lags.[134]

In Table 9.1, none of lagged coefficients of AUSNOIPO exhibit any statistically significant power over USNOIPO. Hence, influence of number of Australian IPOs on the number of US IPOs is not evident. Of note, three out of six lagged coefficients of USSP are positive and significant, which implies that an improvement in stock market conditions precedes increases in the number of IPOs in the USA. This result further confirms the incorporation of stock market variables in the VAR process as control variables.

[134] This result is generally consistent with the finding of Ibbotson et al. (1994) where they observe a first-order autocorrelation of 0.88 in US monthly IPO volume.

Table 9.1: VAR Results of NOIPO between US and Australian IPO Samples

	USNOIPO		AUSNOIPO	
	Coef	T-stat	Coef	T-stat
Intercept	0.008	0.66	-0.001	-0.05
USNOIPO Lag_1	0.495	7.36*	-0.078	-1.15
USNOIPO Lag_2	0.195	2.36*	0.289	4.32*
USNOIPO Lag_3	0.152	1.98*	-0.183	-2.16*
USNOIPO Lag_4	0.107	1.60	0.191	2.23*
USNOIPO Lag_5	0.012	0.17	-0.116	-1.20
USNOIPO Lag_6	0.007	0.11	0.128	1.42
AUSNOIPO Lag_1	-0.059	-1.76	0.273	3.37*
AUSNOIPO Lag_2	-0.062	-1.66	0.103	1.57
AUSNOIPO Lag_3	-0.014	-0.37	0.132	2.13*
AUSNOIPO Lag_4	0.053	1.54	0.031	0.45
AUSNOIPO Lag_5	0.045	1.54	0.079	1.51
AUSNOIPO Lag_6	-0.020	-0.70	0.075	1.16
USSP Lag_1	0.006	3.88*	-0.001	-0.24
USSP Lag_2	0.000	0.23	0.005	1.43
USSP Lag_3	0.002	1.41	-0.005	-1.46
USSP Lag_4	0.006	2.56*	-0.004	-1.21
USSP Lag_5	0.005	2.74*	0.002	0.53
USSP Lag_6	0.001	0.20	0.000	0.07
AUSSP Lag_1	0.002	0.93	-0.001	-0.19
AUSSP Lag_2	0.003	1.37	0.006	1.88
AUSSP Lag_3	-0.001	-0.32	0.003	1.03
AUSSP Lag_4	-0.002	-0.99	0.007	2.21*
AUSSP Lag_5	-0.001	-0.36	0.001	0.17
AUSSP Lag_6	0.001	0.60	-0.001	-0.21
Variance Equation:				
Constant	0.001	1.78	0.001	1.65
ARCH(1)	0.290	4.84*	0.311	5.27*
GARCH(1)	0.710	11.82*	0.689	11.68*
R-Square	0.732		0.605	
F-statistic	56.50*		14.48*	

* denotes significance at 5% level.

For AUSNOIPO in Table 9.1, the first and third lagged coefficients of AUSNOIPO are statistically significant in explaining the current level of AUSNOIPO. This feature of persistence in Australia is consistent with the US results. Compared to the strong autocorrelation observed for AUSNOIPO earlier in Table 5.2, the persistence is somewhat weaker in Australia after controlling for the stock market.

Of note, the second, third and fourth lagged coefficients of USNOIPO also exhibit statistical explanatory power in explaining the current level of AUSNOIPO. The implication is that an upward trend in the frequency of US IPOs transmits to the Australian market in around four months. Comparing sizes of the lagged coefficients on both USNOIPO and AUSNOIPO, the second lagged coefficient of USNOIPO appears to be relatively more important with a value of 0.289. This result confirms that while there is evidence of a direct relationship between previous and current frequency of the number of new issues in Australia, the number of offerings in the Australian market also follows the trend in the US market.

Table 9.2 reports the results of the VAR on GP. For USGP, the results show that the first two and sixth lagged coefficients of USGP are positive and significant in explaining current USGP. This indicates that the current level of USGP is explained by its own lags. Consistent with USNOIPO, none of the lagged AUSGP exhibit any significantly predictive ability over USGP. Hence, there is no evidence of an Australian influence. Of note, the lagged coefficients of USSP are almost all positive (except lag 2) with lags 1, 4 and 5 statistically significant. This result again suggests that a bullish stock market leads to subsequent greater IPO proceeds in the USA.

Table 9.2: VAR Results of GP between US and Australian IPO Samples

	USGP		AUSGP	
	Coef.	T-stat	Coef.	T-stat
Intercept	-0.003	-0.62	0.029	0.37
USGP Lag_1	0.403	6.20*	0.700	2.98*
USGP Lag_2	0.152	2.18*	-0.230	-0.90
USGP Lag_3	0.102	1.54	0.232	0.91
USGP Lag_4	0.010	0.15	0.260	1.04
USGP Lag_5	0.079	1.30	-0.239	-0.95
USGP Lag_6	0.248	6.14*	0.132	0.57
AUSGP Lag_1	-0.003	-0.30	0.118	1.78
AUSGP Lag_2	-0.019	-1.64	0.026	0.38
AUSGP Lag_3	0.014	1.36	0.059	0.89
AUSGP Lag_4	0.024	1.91	0.117	1.75
AUSGP Lag_5	-0.017	-1.61	-0.027	-0.40
AUSGP Lag_6	0.013	1.01	-0.102	-1.55
USSP Lag_1	0.003	2.46*	0.001	0.08
USSP Lag_2	-0.000	-0.16	0.005	0.30
USSP Lag_3	0.000	0.13	-0.012	-0.77
USSP Lag_4	0.003	2.77*	-0.008	-0.51
USSP Lag_5	0.004	2.96*	-0.005	-0.33
USSP Lag_6	-0.000	-0.08	-0.022	-1.45
AUSSP Lag_1	0.001	0.45	-0.009	-0.67
AUSSP Lag_2	0.002	1.57	0.007	0.52
AUSSP Lag_3	0.000	0.31	0.003	0.22
AUSSP Lag_4	-0.001	-1.11	0.015	1.07
AUSSP Lag_5	0.001	0.78	0.001	0.09
AUSSP Lag_6	0.001	1.15	0.014	1.15
Variance Equation:				
Constant	0.000	1.32		
ARCH(1)	0.327	10.38*		
GARCH(1)	0.673	21.36*		
R-Square	0.612		0.224	
F-statistic	78.73*		2.72*	

* denotes significance at 5% level.

For AUSGP, there is no evidence of persistence in gross proceeds in the Australian market. However, the first lag USGP explains AUSGP with a value as large as 0.7. It seems that the total proceeds raised in the US market exert an important influence and tend to lead the total proceeds in the Australian market by one month. However, it is argued that Australian issuers cannot react to favourable US IPO market conditions instantaneously due to the institutional features of the IPO process. Therefore, no strong conclusion can be made about the lead-lag relationship in monthly gross proceeds between the US and Australian stock markets.

In summary, a strong autocorrelation in IPO volume is observed in the US market. Although such persistence is also observed in the monthly number of offerings in Australia, it is not evident in Australian gross proceeds. The VAR results on IPO volume suggest that the current level of IPO volume in the US market is mainly explained by its own lags. The number of US IPOs also has an important effect and leads the number of Australian IPOs by up to four months. In contrast, the lagged Australian IPO volume measures exhibit no significant influence on US IPO volume measures. Therefore, the empirical findings support the hypothesis that there is a uni-directional linkage in IPO volume between Australia and the USA, whereby US IPO volume leads Australian IPO volume.

9.5.2 IPO Underpricing

For USVWUP, the results presented in Table 9.3 indicate that there is a significant positive relationship between current USVWUP and its lags up to two months. This finding of persistence in VWUP in the US market is consistent with the results of Ibbotson et al. (1994) and earlier evidence presented in Chapter five (see Table 5.1).[135] Comparing the magnitude of lagged coefficients, it appears that almost 65% of current USVWUP is explained by its own first two lags. There is no evidence of AUSVWUP leading UVWUP except at the fifth lag of AUSVWUP. However, this lagged coefficient is only 0.023 which suggests low economic importance.

The first five lags of USSP exhibit positive values. This result is consistent with the earlier findings in Chapter eight (see Table 8.4). That is, the influence of stock market conditions on the level of US IPO underpricing is further confirmed. Moreover, the magnitude of the first lag of USSP is the highest among all coefficients.

For AUSVWUP in Table 9.3, neither lagged coefficients of USVWUP nor lagged coefficients of AUSVWUP are significant. Hence, there is no evidence of persistence of VWUP in the Australian market, which is consistent with the autocorrelation results reported previously in Table 5.2. Of note, the second, fourth and sixth lagged coefficients of AUSSP are positively significant. This finding indicates that the degree of IPO underpricing in Australia has an association with prior stock market conditions, consistent with the US evidence. Of note, the R-square obtained for the model on AUSVWUP is only 13.1% and the insignificant F-statistics fail to reject the null hypothesis that all coefficients are jointly zero. An implication from these results is that monthly underpricing in Australia generally appears to be unpredictable, given the model.

[135] A first-order autocorrelation of 0.62 in the monthly average initial return in the US market is observed in Ibbotson et al. (1994).

Table 9.3: VAR Results of VWUP between US and Australian IPO Samples

	USVWUP		AUSVWUP	
	Coef	T-stat	Coef	T-stat
Intercept	0.430	0.50	24.917	3.51*
USVWUP Lag_1	0.392	4.36*	0.027	0.06
USVWUP Lag_2	0.255	4.09*	-0.885	-1.91
USVWUP Lag_3	-0.051	-0.84	0.646	1.36
USVWUP Lag_4	0.093	1.39	-0.566	-1.20
USVWUP Lag_5	-0.008	-0.13	0.183	0.40
USVWUP Lag_6	0.083	1.70	-0.269	-0.66
AUSVWUP Lag_1	-0.010	-1.15	-0.036	-0.55
AUSVWUP Lag_2	-0.005	-0.56	-0.099	-1.50
AUSVWUP Lag_3	-0.005	-0.62	0.062	0.93
AUSVWUP Lag_4	0.010	0.78	-0.064	-0.96
AUSVWUP Lag_5	0.022	4.51*	0.023	0.36
AUSVWUP Lag_6	0.008	1.39	0.049	0.76
USSP Lag_1	0.423	4.62*	1.192	1.34
USSP Lag_2	0.191	1.79	0.451	0.46
USSP Lag_3	0.399	3.70*	0.783	0.79
USSP Lag_4	0.272	2.24*	-0.207	-0.21
USSP Lag_5	0.096	0.75	0.526	0.53
USSP Lag_6	-0.237	-2.28*	-0.175	-0.19
AUSSP Lag_1	-0.083	-0.90	-1.069	-1.27
AUSSP Lag_2	-0.101	-0.90	1.933	2.26*
AUSSP Lag_3	-0.178	-1.95	-0.719	-0.82
AUSSP Lag_4	-0.167	-1.60	3.102	3.57*
AUSSP Lag_5	0.057	0.55	-1.600	-1.83
AUSSP Lag_6	-0.033	-0.39	2.003	2.57*
Variance Equation:				
Constant	12.114	3.41*		
ARCH(1)	0.883	8.45*		
GARCH(1)	0.117	1.12		
R-Square	0.317		0.131	
F-statistic	19.01*		1.42	

* denotes significance at 5% level.

Table 9.4 reports the VAR result of VUP. For USVUP, the first two lags and sixth lagged coefficients of USVUP exhibit significant results. Over 54% of current USVUP is explained by the first two lags of itself. The insignificance of lagged coefficients of AUSVUP suggests that lagged AUSVUP has no influence on the current level of USVUP.[136] Considering the results of both USVWUP and USVUP, it appears that the US IPO underpricing is largely explained by its own lags and prior US stock market conditions.

Consistent with the VAR results of AUSVWUP, the analysis on AUSVUP in Table 9.4 indicates that neither lagged coefficients of AUSVUP or lagged coefficients of USVUP are statistically significant. The F-statistic fails to reject the null hypothesis that all coefficients are jointly zero. In other words, no variable in the model explains the monthly value of underpricing in Australia. Of note, the R-square obtained for this model is the lowest among all models across Tables 9.1 to 9.4.

[136] Although the fifth lag of AUSSP is negatively significant, no strong conclusion can be made as we expect a shorter lead-lag relationship.

Table 9.4: VAR Results of VUP between US and Australian IPO Samples

	USVUP		AUSVUP	
	Coef	T-stat	Coef	T-stat
Intercept	0.008	1.29	0.257	2.31*
USVUP Lag_1	0.372	5.90*	-0.125	-0.53
USVUP Lag_2	0.172	3.96*	-0.001	-0.00
USVUP Lag_3	0.021	0.34	0.069	0.25
USVUP Lag_4	0.070	1.11	-0.021	-0.08
USVUP Lag_5	0.068	1.13	0.003	0.01
USVUP Lag_6	0.134	2.84*	0.198	0.86
AUSVUP Lag_1	-0.002	-0.57	0.034	0.52
AUSVUP Lag_2	-0.004	-0.62	0.001	0.02
AUSVUP Lag_3	0.003	0.57	0.039	0.58
AUSVUP Lag_4	-0.005	-0.99	-0.035	-0.53
AUSVUP Lag_5	0.001	0.06	0.084	1.26
AUSVUP Lag_6	-0.001	-0.14	-0.030	-0.45
USSP Lag_1	0.004	3.43*	0.027	1.27
USSP Lag_2	-0.004	-2.61*	0.019	0.80
USSP Lag_3	0.003	1.94	0.011	0.49
USSP Lag_4	0.004	2.70*	-0.006	-0.27
USSP Lag_5	0.005	3.85*	-0.004	-0.16
USSP Lag_6	-0.001	-0.73	-0.020	-0.91
AUSSP Lag_1	0.002	1.27	-0.036	-1.77
AUSSP Lag_2	0.001	0.70	0.014	0.67
AUSSP Lag_3	-0.001	-1.23	-0.001	-0.06
AUSSP Lag_4	-0.003	-2.27*	0.045	2.17*
AUSSP Lag_5	-0.000	-0.28	-0.004	-0.22
AUSSP Lag_6	0.001	0.81	0.032	1.79
Variance Equation:				
Constant	0.001	2.54*		
ARCH(1)	0.510	11.06*		
GARCH(1)	0.490	10.61*		
R-Square	0.569		0.061	
F-statistic	51.36*		0.61	

* denotes significance at 5% level.

In summary, the measures of IPO underpricing in the US market are strongly explained by its first two lags. While there is evidence of persistence in the US market, there is no similar evidence in the Australian IPO market. IPO underpricing in the USA appears to be explained by its own lags and prior stock market conditions. In contrast, neither lagged underpricing in the USA or lagged underpricing in Australia exhibit any predictive ability over the current level of underpricing in Australia. This implies that monthly IPO underpricing in Australia is largely unpredictable. While we posit that there is a (weak) linkage in monthly IPO underpricing between Australia and the USA, the empirical results indicate this linkage does not exist. This result is somewhat surprising, but may be explained by the fact that resource sector IPOs consist of 32% of total Australian new issues over the period in comparison to only 3% in the USA (see Chapter four). This implies that companies going public in the two markets have different characteristics. Since resource sector IPOs are characterised by smaller offer sizes and larger underpricing (see Chapters four and seven), resource IPOs are expected to have a substantial influence on the aggregate underpricing measures in Australia.[137] In fact, the results obtained in Chapter seven have already confirmed the influence of resource sector IPOs on the aggregate underpricing measures in Australia. There might be other reasons for this finding, however, I leave it for future research.

[137] Refer to Chapter five for the construction of the IPO underpricing measures.

9.6 Summary and Conclusion

This chapter has investigated the linkage between the US and Australian IPO markets. By incorporating stock market conditions from both countries, the IPO activity measures for both markets are examined through a VAR model.

Strong autocorrelation is observed on all US IPO activity measures (both IPO volume and underpricing). In addition, all US IPO activity measures appear to be influenced by prior US stock market conditions.

The results on the monthly number of new issues suggest that an upward trend in the frequency of US IPOs transmits to the Australian market in around four months. This result confirms the leading effect of US IPO volume on Australian IPO volume. However, the lead-lag relationship is not evident in other measures, such as IPO underpricing.

Although there is evidence of persistence in the monthly number of offerings in Australia, this feature is not evident in other Australian IPO measures (AUSGP, AUSVWUP and AUSVUP). while the number of IPOs in Australia appears to follow the general trend in the US market, and there appears evidence of a relationship between Australian IPO underpricing and previous local stock market conditions, neither lagged underpricing in the USA or Australia exhibit any explanatory power over the current level of underpricing in Australia. We argue that IPO underpricing in Australia is largely unpredictable and is more likely to be affected by issuer-specific features.

CHAPTER TEN

SUMMARY AND CONCLUSIONS

10.1 Thesis Summary

This chapter provides a summary of the thesis and briefly comments on directions for future research.

This thesis is primarily an empirical study on the behaviour of aggregate IPO markets using long-term US and Australian data. Following the introduction, Chapter two contained a literature review of theoretical and empirical issues related to IPO underpricing. The chapter first reported international evidence on IPO underpricing and was followed by a discussion of financial characteristics of IPO underpricing. Reasons for IPO underpricing were subsequently discussed and classified into four categories, being information asymmetry, investors, the market and institutional framework, and the impact of financial intermediates.

The literature review concerning the behaviour of IPO markets was presented in Chapter three. The chapter provided a definition of hot issue markets based on the literature and empirical evidence relating to cycles in the IPO activity. Section 3 of the chapter detailed the existing explanations for cycles in IPO activity. Of note, none of the existing explanations appear to provide a full explanation. Moreover, previous studies have generally concentrated on supply side arguments but the importance of demand for IPOs is often overlooked.

Several economic variables were suggested to be potentially important in explaining cycles in IPO activity.

Chapter four described the data collection procedures and sources of IPO data. With consideration of several empirical issues, a sample of 6,632 IPOs for the period January 1976 to June 1998 was collected for the US market and a sample of 766 IPOs over the period January 1976 to June 1997 was collected for the Australian market. Detailed summary statistics were provided for both markets. The results indicate that the Australian IPOs exhibit a relatively higher average initial return than those of the USA. In addition, resource sector IPOs consist of 32% of total Australian new issues over the period in comparison to only 3% in the USA. Separate consideration of industrial and resource sector IPOs in Australia suggests that resource sector IPOs are generally smaller in size and exhibit greater underpricing.

Since we focus on aggregate IPO markets and exploit the question of hot and cold issue periods, four measures of IPO activity were developed in Chapter five. While NOIPO and GP measure IPO volume, VWUP and VUP measure underpricing. Although NOIPO and GP follow traditional measures, VWUP is an improvement on existing research and VUP is a newly developed measure. For the US IPO sample, the two volume series exhibit a similar pattern over time. Although there are differences in behaviour between volume and underpricing in both the USA and Australia, the underpricing series appears to lead the volume series. Further, separate consideration of the industrial and resource sectors in Australia indicates that underpricing in resource sector IPOs appears to be larger and less persistent than their industrial counterparts. Consistent with the US results, the plots of Australian IPO activity measures also suggest a potential lead-lag relationship between the volume and underpricing measures. Of note, there also appears to be a correlation in the corresponding volume measures between Australia and the USA

Chapter six involved formal identification of hot and cold issue periods in the four IPO activity measures in the USA. The IPO activity measures were analysed in order to provide a multi-dimensional characterisation and identification of hot and cold IPO markets. Several research techniques were used, including visual analysis, a dating algorithm developed by Bry and Boschan (1971) and a Markov regime switching model. The results confirm the existence of hot and cold issue periods in the US market with the documentation of a number of hot and cold periods in the various IPO activity measures. It is evident that hot periods are generally characterised by a higher mean and volatility, as well as longer duration, when compared to cold periods. Moreover, hot issue periods appear to be related to general business and stock market conditions. A lead-lag relationship between underpricing and IPO volume is also identified, whereby underpricing appears to lead volume by up to six months. This relationship supports the contention that the decision to issue is a function of current underpricing.

Chapter seven focussed on the aggregate IPO market in Australia. The empirical results support the existence of hot issue periods across all measures of IPO activity in Australia. Separate consideration of the industrial and resource sectors suggests that industrial sector IPOs dominate Australian IPO issuance in terms of both number of issues and value. Resource sector IPOs are found to be relatively small in size and exhibit greater underpricing. While there is evidence of a lead-lag relationship between underpricing and IPO volume for industrial sector

IPOs, such a relationship is not evident in resource sector IPOs. Consistent with the US results, hot issue periods appear to be associated with the general stock market conditions across all measures of IPO activity.

With the evidence of hot and cold issue markets observed in Chapters six and seven, several hypotheses were developed by considering both demand and supply factors to explore the underlying causes of hot issue IPO markets in Chapter eight. The variables suggested are, changes in the business cycle leading indicators, stock market return, stock market volatility, unexpected mutual fund flows and discounts on closed-end funds. Applying both OLS and probit analysis, the hypotheses are largely supported. All economic and stock market variables exhibit explanatory power over the number of firms going public and appear to influence the probability of hot issue periods in IPO volume. Hot issue periods in IPO underpricing appear mainly explained by changes in the stock market level and the business cycle leading indicator. The similarity of the OLS and probit results confirm the accuracy of identified hot and cold periods through the prior application of the regime switching technique.

Chapter nine examined the financial linkages in the IPO activity measures between the USA and Australia. We posited a linkage in the IPO volume measures between the two markets, and a (weak) relationship in the IPO underpricing measures. There is evidence that the frequency of Australian IPO follows the general trend of the frequency of US IPOs though no linkage is observed in underpricing between the two markets. Of note, all US IPO activity measures exhibit strong persistence while persistence is only observed in the number of offerings in Australia. Moreover, Australian IPO underpricing appears to be more unpredictable.

10.2 Future Research

This thesis has provided evidence of hot and cold new issue markets in the USA and Australia by examining IPO activity measures over the period January 1976 to June 1998. Some of the evidence was confirmatory in nature, which adds to knowledge in this area, but most of the evidence was new. The original tests provide fresh insights into unresolved issues. However, despite the evidence presented in this thesis, there remain some unanswered questions.

First, Chapter eight showed that aggregate IPO underpricing in the USA can be explained by economic and stock market variables. Underpricing appears to be also explained by other factors, such as firm-specific characteristics. In this thesis, the causes of hot issue periods in the IPO activity measures were examined with consideration of economic and stock market variables. However, these variables need not be the only variables stimulating cycles in IPO underpricing and volume. Hence, future research can consider the effect of financial features of individual IPOs as well as general stock market and economic conditions. Second, the institutional and regulatory features of the IPO process appear to be important in the study of the aggregate IPO activity and this is often overlooked. Third, the results indicate that the feature of persistence is generally not evident in the Australian IPO market while this feature is strongly evident in all US IPO activity measures. Further analysis of the reasons for this difference would be interesting. Fourth, hot issue periods identified using the Markov regime switching technique appear to largely capture the cyclical behaviour of the IPO activity. However, this technique can be further improved by incorporating duration and volatility features of hot and cold issue periods. Fifth, this thesis shows differences in the pricing behaviour of resource sector IPOs in Australia when compared to their industrial counterparts. Resource sector IPOs exhibit a substantial influence on the Australian aggregate underpricing measures. Further detailed analysis on the different characteristics of resource and industrial sector IPOs will add to our understanding of IPO markets. Finally, there is still more international evidence required before we can fully understand, if ever, these intriguing markets.

In summary, this thesis provides evidence on the existence of hot and cold issue markets in both the USA and Australia. The underlying causes of hot issue markets were examined and stock market and economic conditions as well as investor sentiment proved to be important. The evidence of the influence of the US IPO activity on the Australian IPO market was also reported. While it is not possible to answer all questions, the insights gained in the thesis have provided a launching pad and a framework for future research.

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